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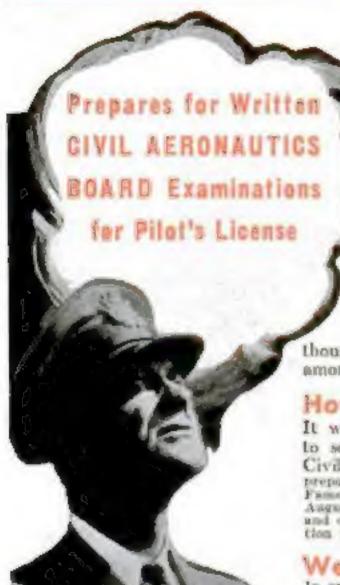
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Mechanics & Handicraft

SEPTEMBER 15¢

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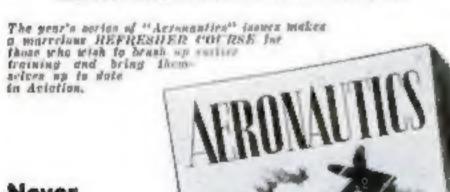
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Founded 1872

Mechanics & Handicraft

Volume 137, No. 9

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Enlarging the Panama Canal.....

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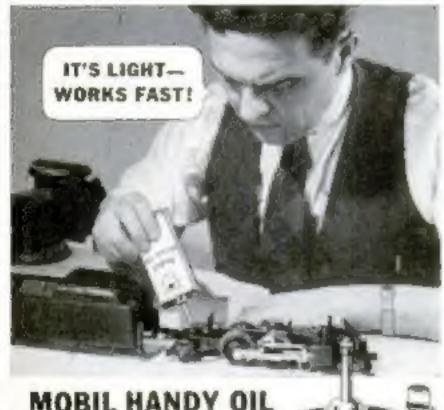
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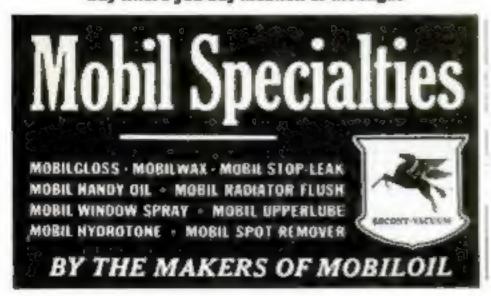
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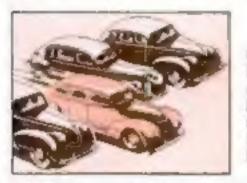


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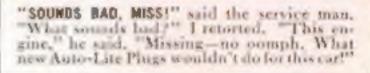
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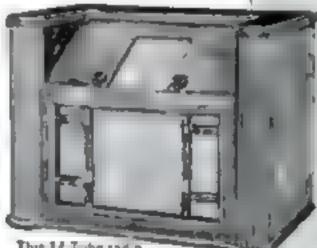
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SEPTEMBER, 1940

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()ur Readers Believe in Miracles?

Read This Anyway!

Support you were watching a building going up, and your eye happened to fall upon a stray brick lying on the ground. What would be your feelings if you saw that brick auddenly rise and sail through the air into the hands of a bricklayer on the third floor? No, you wouldn't be seeing things, according to a book I've just been reading. It could

AW SAVE TIME AND USE

happen perfectly naturally, and the reason is simple. The brick consists of innumerable atoms, moving every way at random. By pure chance, there is always the possibility that "once in a blue moon" the atoms might all jump the same way simultaneously. And prestothe brick goes soaring aloft! How remote is

the possibility? Well, a mathematician named Parrin has taken the pains to figure it out. According to his calculations, a brick might be expected to act in this astounding way just once in the number of years represented by one followed by ten billion ciphers. So you can safely bet against it; but it would still be just as likely to happen in 1940 as, say, in the year 100,000 A.D. Sort of makes you believe in miracles, doesn't it?-A. G. B., Sacramento, Calif.

It Wasn't a Hunting Trip, But He Shot the Sun

Coming out of the woods after a week's camping trip recently, I began to worry about whether I would catch the train that would take me back to civilization. I had a watch with me, but it had had such rough treatment that I could not be sure that it was within an hour of the correct time. So, to reassure myself, I "shot the sun" at noon by observing when it cast the shortest shadow. Knowing that I was right on the eastern edge of the Central Time Zone, I was able to figure pretty closely the time when the sun should reach the meridian, and found that my watch was within five minutes of the correct time. It amused me to think that I was just reversing the method by which navigators determine their longitude. Also, it made me think a whole lot more of my faithful old watch. P.S.: I made the train. -L. T., Asheville, N C.

There's No Telling What You May See in This Picture

THE longer I looked at the photograph in the lower right-hand corner of page 153 in the August issue, the more familiar faces I saw in it. First it was Herbert Hoover. Then the inscrutable stars of the Sphing. Popeye

the Sailor emerged after a while, and then Winston Churchill, The famous Cheshire cat. no less famous for the Tenniel illustration of it, grinned out at me after a while, and, well, give it a try yourself. No matter whom you may see, he or it, as the case may be, is sticking his tongue out at you. The contributor who aubmitted this



item deserves a bonus for packing so much material into a wrinkled paper bag and a bent clothes hanger.-S. J. S., Ann Arbor, Mich

Why Photographers Turn Gray— That is, One of the Reasons!

Will some camera fan please come to my assistance with a plan! Anything short of a traveling darkroom will do, so long as it is foolproof. You see, last night I went to work with all the equipment I own to get one good picture of my eight-week-old offspring. Flash bulbs, reflectors, wiring, lens shade, exposure tables, camera, tripod, and so forth, were

made ready with the greatest of care. The "sitting" was unusually simple and cooperative, considering the subject's usual and somewhat precocious distrust of a camera lens. (He'll never "go Hollywood" on me.) When all finished, I repaired to my darkroom and unloaded my cut-film holders-all twelve of them. Nine



were empty. You see, in my enthusiasm for the task in hand, I completely forgot that I'd done some picture taking and developing a week ago and had not reloaded afterward. All I ask is something to put on each film

(Continued on page 12)



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Name_____

Address

Our Readers Say CONTINUED

holder that will shout out loud when I pick it up whether it is empty, or loaded and unexposed, or loaded and exposed. What to do! —T. U., Columbus, Ohio.

Winging Pop Bottles at the Ump Teaches Us Something

On TERRING to page 87 of the August issue, I was amused by the picture of a soldier from some European army testing an antitank bomb consisting of a pop bottle filled with an inflammable liquid. Maybe it isn't very

HOPE THIS LOOKS GOOD IN THE NEWS REELS!

polite to laugh at others, but I got a good laugh at the pose the soldier is striking as he throws (?) the homb. Left hand on hip, he has just let fly with the bomb by a sideward flick—just that—of his right arm. Any American boy between six and sixty who threw anything with that technique would be laughed of

the sand lot, and any baseball fan between Brooklyn and Podunk Center who couldn't wing a pop bottle with more finesse at an umpire, wouldn't even be allowed in the bleachers.—E. S. B., St. Louis, Mo.

Insomnia Is No Problem —in the Classroom!



Turre's nothing new under the sun. In your August issue, you tell about a college course given at Columbia University which makes students sleep soundly. That's old stuff. We have professors at my college who have been doing that for twenty or thirty years—and without trying!—E. M. J., New York City.

First Bullet, O. K., Second Bullet, Ixnayl

Just received July issue of P.S.M. today and am enjoying it very much. I always read it from cover to cover. Particularly interesting is the Gus Wilson Model Garage story. Our Readers Say, and With the Inventors. One thing amuses me this month in the latter. It is the military helmet designed by Percy L. Crosby that is supposed to bounce bullets aside. After looking it over, I found

myself wondering just what would happen if a second builet came along before the crown was pulled back to the brim of the hat by the coll springs—M. L. Z., Taneytown, Md.

Don't Smash Any Umbrellas Figuring This One Out

The trouble with N S.'s little algebra problem, proving by algebraically correct steps that 1 is equal to 2, lies in the fact that the

factor (1—x), on each side of his equation x (1 x)...(1-x) (1 x), is equal to zero; this because x equals 1, as given, and 1—1 equals zero. Now anything multiplied by zero equals zero, so the other factors need not be equal. They were not, as it turned out, and the equation bolled down to the obvious error. It seems to be



customary to answer one probem with another, so I retaliate with one involving a bit of trigonometry: A nine-ribbed umbrella is stripped of its fabric covering so that its ribs are straight even when they open. They are opened so that each rib makes an angle of 15° 13' with the center stick. Find the angle any rib makes with one next to it, and I hope it doesn't rain before you get a new umbrella.—P. M. D., Columbus, Ohio.

He'd Like To Read a Story on Nonfraudulent Spiritualists

Some time ago, you published an article in your magazine exposing the methods em-

ployed by fraudulent spiritualists. I should like to see another article covering phenomena which have not been proved fraudulent, and possible scientific explanations. This would prove very interesting, as would an article on present-day findings in the realm of mental telepathy. Incidentally, your new arrangement makes



things of interest much easier to find, in my opinion.—W. S. P., Corry, Pa.

That Article on Future Cars Is Still Hitting on All Cylinders

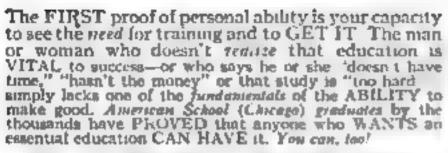
to bounce My MORNING paper recently summarized a talk made by David Beecroft, a past presi(Continued on page 14)

Step Up Where You Belong

What Is Your Present Level of Preparation?

Business Executive

Nurse



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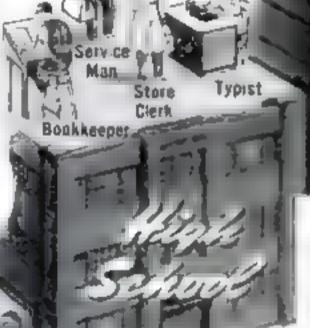
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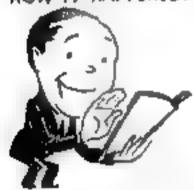
Our Readers Say CONTINUED

dent of the Society of Automotive Engineers. at a meeting of that organization at White Sulphur Springs, W. Va. I note that he points out that the future will bring cars of entirely different basic design from those of today, as did your article in the June issue. "New Patents Forecast the 1942 Car." They will have engines in the rear, said Beecroft, as did your article. And he declared that they will have a superstructure integral with the chassis, as did your article. Both the speaker and your article pointed to evolutionary trends in car design, and predicted what the future car would be like if the trends continued. I would like very much to have heard Beecroft's talk, as I am intensely interested in the subject. At the same time, I doubt if I would have enjoyed it any more than I did your article. In telling what care of the future will be like, the author of your article did a splendid job, basing his predictions on sound reasoning. Good stuff! Let's have more like it!-F. L. New York City

The Ice Age Was a Myth, Declares This Reader

REPLYING to B. L.C., Trumansburg, N. Y., in regard to the Ice Age, will say that the Ice Age is only a myth. If not, why do we find the skeletons of animals, also the bodies of perfectly preserved mastedons and other

THAT WAS THE ICE AGE, NO MATTER HOW IT HAPPENED!



creatures that once lived in a hot country? At one time there were continents in both the Pacific and Atlantic oceans, which were sunk by an earthquake so terrific that it caused a tidal wave that swept over what is now known as Manchuria, carrying everything north in its path Buried cities are found in that country to this

day. When the water receded, it brought down the ice over both hemispheres, destroying nearly everything, preserving some things. All this was many centuries ago, some estimate it as far back as 70,000 years.—W. L. G., Oakland, Calif

There's No Use Trying It, Even in Modern Warfare

Your recent article on coast-defense guns reminds me of a rather priceless comment once made by Admiral William D. Leahy, then Chief of Naval Operations, U.S. N., before a Congressional committee. Here is the official record of the testimony: "Senator Gerry: It is an old, established naval policy, is it not, that you cannot attack successfully land fortifications with even capital ships if

these land fortifications are modern and in proper condition? Admiral Leahy: I think it would require a very dire necessity to induce any naval commander to take his fleet under the fire of modern shore batterles. Senator Gerry: Because the advantage is entirely with the shore battery, is it not? Admiral Leahy: The shore battery has one very decided advantage. It does not sink when it gets hit with a shell." I think that rates the Admiral as something of a wit.—B. T., Newark, N. J.

Father Burned His Fingers When He Bought That One!

THE curious, self-destructive pepper shaker that A. D. N., of Vancouver, B. C., writes about, reminds me of what happened once when I was a small boy, before electric

a good lamp chimney was an important matter. Father bought one that was supposed to be shock and heatproof. To show it could take it, the dealer threw it over his head, and it fell to the floor without breaking We used it for several weeks, when one night, as usual, Father blew out the light and went



to bed. After the chimney had time to get thoroughly cooled, we all heard a loud explosion, similar to a pistol shot. We found the lamp chimney blown into hundreds of tiny pieces, and scattered all over the room. Maybe some reliable glass factory can explain it. At the time, we found no one who could—A. H. B., Los Angeles, Calif.

And the People of Florida Might Like To Keep Their Gulf Stream

H. I. C.'s idea about pumping Gulf Stream water to the antarctic is a pretty impractical

one, I think. In the first place, it would be virtually impossible to lay a pipe line that far, not to mention the cost of keeping the pipe in condition. In the second place, the cost of pumping would be terrific. And in the third place, why not pump the Gulf Stream water to New England where we wouldn't have to travel several

WE COULD FORGET THE IDEA!



thousand miles to take advantage of it, if he's so stuck on pumping it?—J. G. G., Gainesville, Fla.



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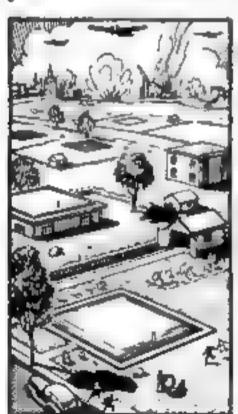
With the Inventors

WHAT are the greatest American inventions? A committee of seventy-five scientists and industrial leaders recently examined eighty outstanding American



inventions and selected nineteen for the roll of honor. Try making your own list before you read the roster that follows. Eli Whitney's cotton gin: Robert Fulton's steamboat: Cyrus Hall McCormick # reaper: Samuel F. B Morse's telegraph; Charles Goodyear's rubber vulcanization process: Ehas Howe's sewing ma-

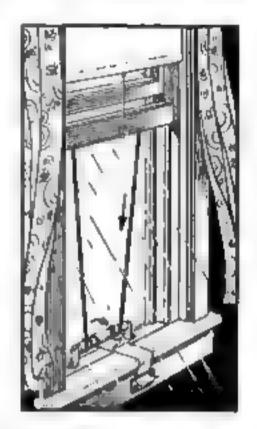
chine; Christopher L. Sholes's typewriter; George Westinghouse's air brake; Alexander Graham Bell's telephone; Thomas A. Edison's phonograph, incandescent lamp, and motion-picture projector; Nikola Tesla's induction motor; Charles M. Hall's aluminum process; Ottmar Mergenthaler's linotype machine; Wilbur and Orville Wright's airplane; Lee De Forest's three-electrode vacuum tube; Leo Backeland s synthetic plastics; and William M. Burton's oil-crack-



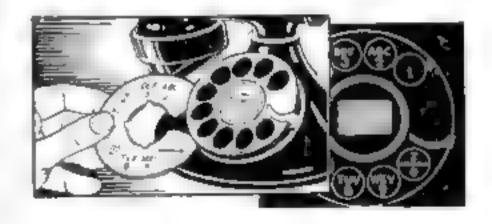
ing process. And suppose you had to select the three greatest inventions from this list of nineteen - send & note and let us know which trio you would choose ... FOR PROTECTION AGAINST the ravages of dust storms, hurricanes, tornadoes, and bombs dropped from the skies. Andre D'Amico, of Rochester, N. Y., suggests homes that can be made

to disappear into the ground. Built over a pit dug in the earth, the two-story structures are lowered into the hole by means of a hydraulically operated plunger so that their reenforced metal roofs are flush with the ground level. Movable bolts attached to the houses rest on a ground-level ledge to sup-

port the structures when in their normal raised positions . . . HARDLY A SINGLE WEEK passes without the issuance of at least one patent for some new kind of a coat or garment hanger . . . IF A DRIVING rainstorm comes up during the night, you'll find your windows will close automatically If they are equipped with a device worked out by Peter Pusak, of



Eddystone, Pa. Wires attached to the window sash are fastened to a spring-operated roller mounted on the sill. When the window is open a strip of special paper holds the roller against the action of its spring, but when rain or fire causes the paper strip to break, the roller is free to draw the open window down to a closed position . . . WHAT ARE BELIEVED to have been the first patents ever issued in the world were granted by the ancient Greeks to their chefs, to encourage the invention of new palate-tickling food concections. Wonder who got the first patent on hash . . . WITHOUT CHANGING or removing any telephone parts, an attachment developed by George I. Dormont, of



Los Angeles, Calif., provides luminous numerals to make it easy to dial numbers in the dark, or in phones located in badly lighted corners or booths. Made of metal, plastic, or heavy paper in a dark color, the attachment consists of a flat ring that fits in

(Continued on page 18)



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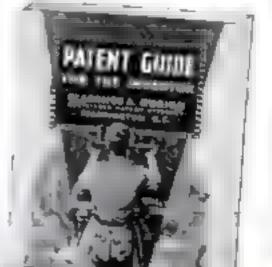
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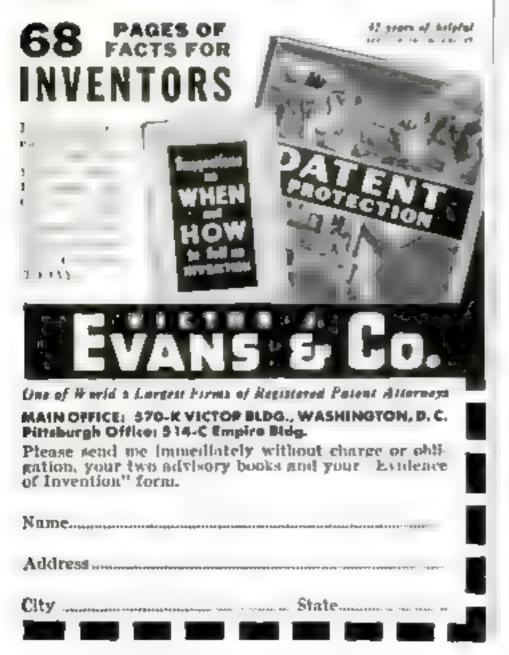
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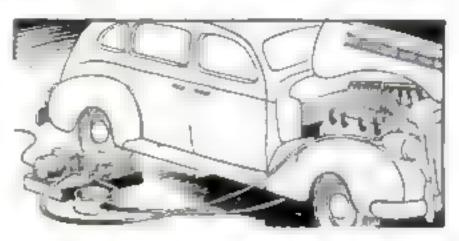
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With the Inventors

(Continued from page 16)

place over the standard ring bearing letters and numerals. The accessory duplicates the marking of the original, but with some such luminous material as phosphorescent paint or a radium-salt composition . . . The REGISTRATION OF commercial prints and labels has been transferred from the juris-



diction of the Commissioner of Patents to that of the Register of Copyrights in the Library of Congress... An EASIER METHOD OF REMOVING carbon from an automobile engine than the common practice of removing the cylinder head and scraping or burning carbon from the affected parts, is outlined in the specifications for an apparatus credited to George Hofele, of St. Louis, Mo. Rollers turned by an electric motor drive the rear wheel of a car, and since the engine is left in gear, the pistons are set in motion. A pump forces a special liquid through a tube into a manifold which distributes the carbon-dissolving fluid to all

cylinders through spark-plug and carburetor openings. The exhaust manifold of the engine is blocked to prevent the liquid from being discharged during the cleaning process . . . DRAWINGS IN PUBLISHED PATENTS for new plants appear in full color . . . No screws, NAILS, or other type of permanent attachment is needed to hold in place novel brack-



ets designed by James H. York, of Cincinnati, Obio, to support both a window shade and curtains. Made of metal, the brackets are provided with separate notched

(Continued on page 20)

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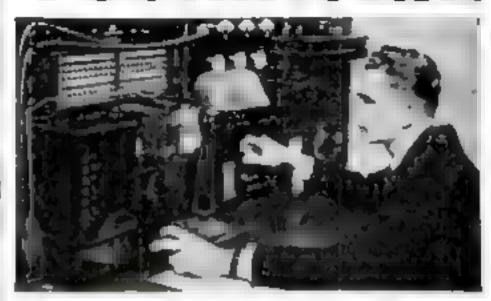
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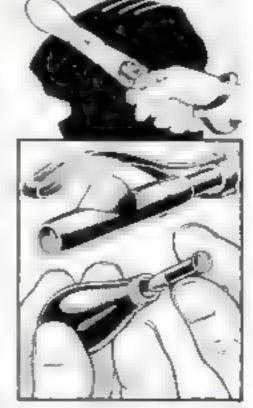
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extensions that hold a shade next to the window and a curtain rod a short distance out from it. One end of the bracket rests flat against the wall near the top of the window, while a curved arm, toothed at one end,



bends up and around the molding above the window to anchor the accessory in place . . . THE COMPLEXITY OF the job of classifying U. S. patents is indicated by the partial definition of one subclass in the Patent Office: "Mechanisms for releasing or tripping portions of machines to cause other portions to automatically operate." . . . A MULTIPLE CANDLE, constructed in various patterns that give it a number of wicks, is the work of Cameron Turner, of Beverly, Mass. The birthday-cake type shown in the illustration starts out with flames burning from each of ten wicks. As the paraffin melts and candle height decreases, Twenty flames will be burning as each candle branch divides into two. Later, the flames will decrease to ten, and then increase to twenty once more. The curious and novel candles

may be made in a large number of decorative designs . . . TO BE PATENT-ABLE, an invention must operate as described, but it need not be perfect . . . A WEAPON THAT recommends itself for police use is a combination blackjack and a one-shot gun. Equipped with a built-in, springoperated firing pin, the weapon is loaded by removing the barrel and inserting a cartridge. A



thumb-operated trigger fires the gun, and a safety mechanism prevents accidental discharge when it is used as a club. Jesse M. Bohler, of Atlanta, Ga., is the inventor.

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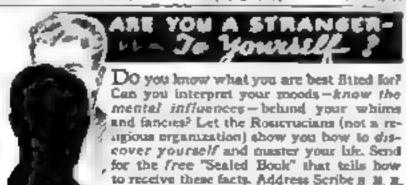
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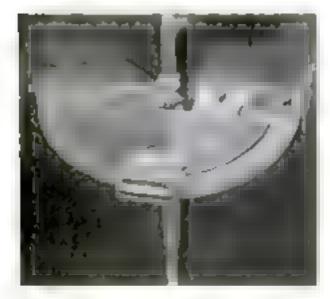
Windows slide on steel guides, as shown below. In the photograph at the left, one of the frames is being lifted out for washing



Windows Slide Horizontally and Are Easy To Take Out

SLIDING WINDOWS that resemble casement types when closed, and require no sash weights or hinges, are now on the market. Each sash slides horizontally on polished steel glides, guided by a head and sill track. Both sashes lie in the same plane when

closed, but one pulls inward and slides past the other to afford a single large opening Sliding both sashes forms an opening at either side of the units, which may easily be removed for cleaning or installation of double glazing for winter use.

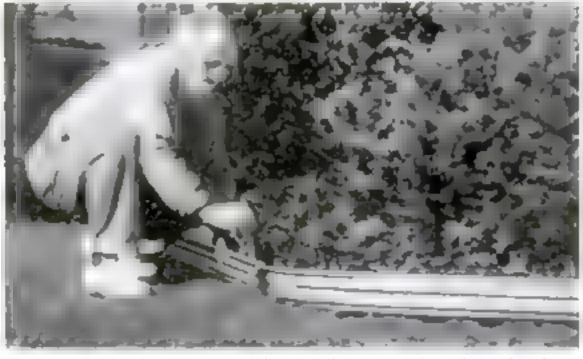


Holder Locks Door at Various Angles

Doors may be held firmly in place at various angles by a new holder designed to be mounted on the door at the hinge. Made of steel plated with brass, the device will hold a door steady at five different angles under ordinary conditions, even when windows are open and a breeze is blowing

Metal Edging Makes Neat Lawns

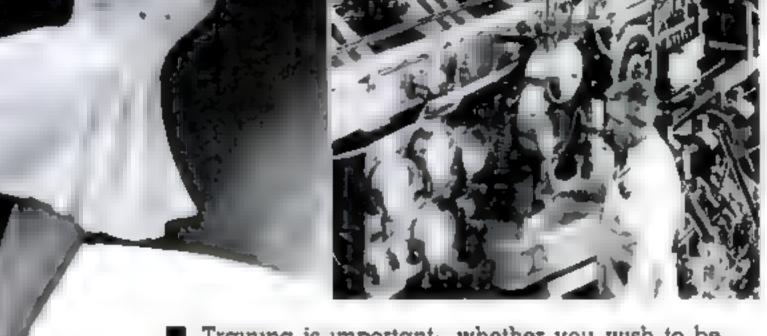
To HELP give a neat appearance to driveways, walks, flower borders, and other features of a lawn, easily installed metal edging is now available. Made either of zinc alloy or galvanized steel, the material comes in interlocking strips that are driven into the ground and supported by metal reënforcing stakes.



Reënforcing stakes support the metal edging along lown borders



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Paint Brushes Cleaned by Dipping in Solvent

PAINT BRUSHES are easily cleaned after use, without soaking in water or oils, by dipping them in a new solvent that quickly dissolves the paint on the bristles, and emulsifies it so that the pigments and oils can be rinsed away instantly under a water tap. The solvent is said to have no harmful effect on bristles.

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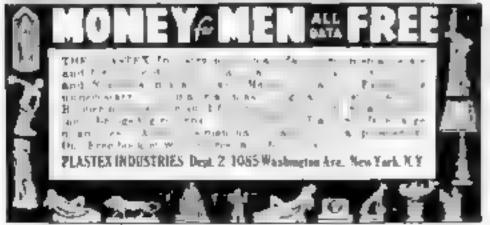
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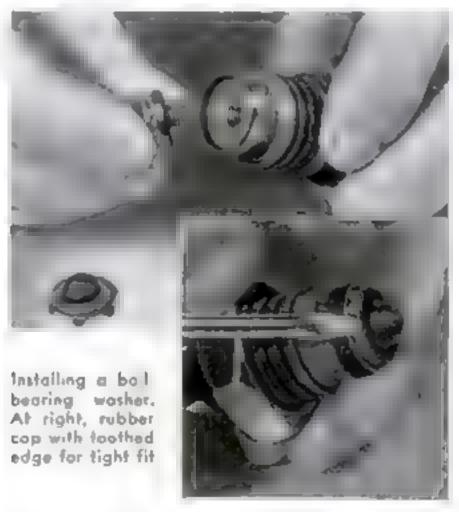
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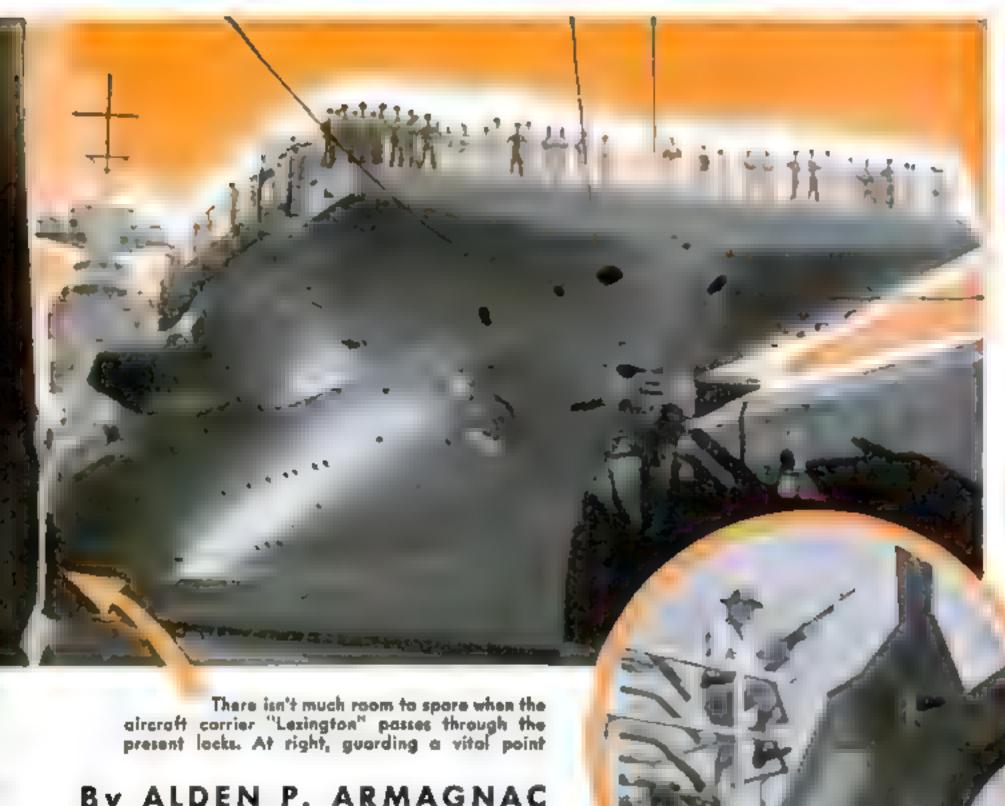
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Enlarging the Panama



By ALDEN P. ARMAGNAC

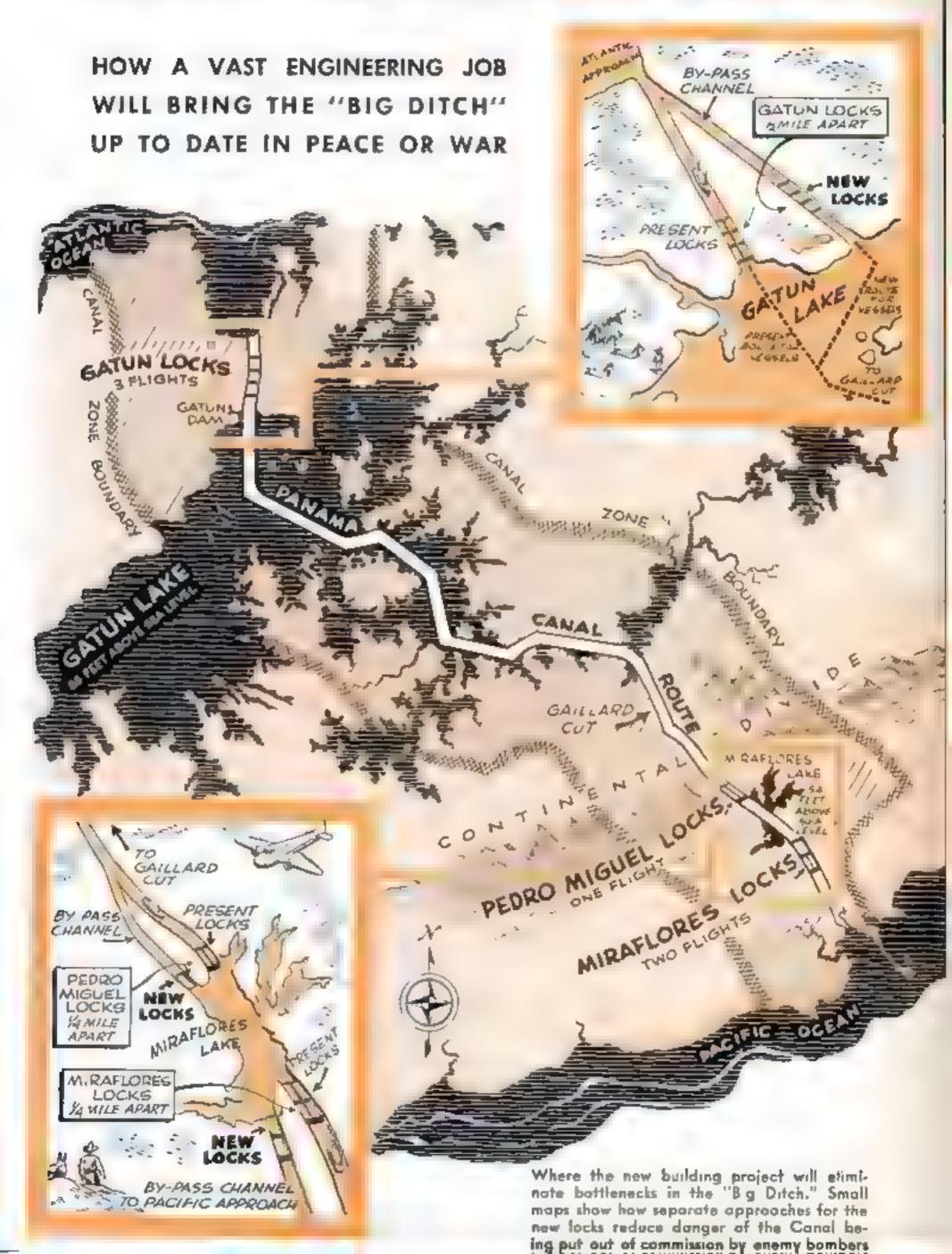
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The giant engineering scheme calls for conversion of the present "two-lane" canal across the Isthmus into a "three-lane" canal. To do this, three sets of oversize singlechamber locks will be built, parallel to the present twin-chamber locks but at some distance from them. There will be no need to dig a whole new canal, since the "Big Ditch" itself will easily carry the traffic.

Why the new locks? First and foremost,

they will assure the U. S. Fleet of unobstructed passage between the oceans, in cases of emergency. Canal authorities long have been jittery over the possibility of sabotage or direct attack on the present locks. A vessel might be blown up, or time bombs might be dropped, in a lock chamber; or the locks might be bombed by raiding planes. If a heavy explosion or a lucky hit from the air happened to destroy two sideby-side lock chambers at once, the entire Canal would be put out of commission. Therefore, for many months, a force of sev-

Canal for bigger battleships



eral thousand men has been working night and day to equip the old locks with "special protective devices" of a secret nature. But the Navy will feel still more comfortable when the new locks are built, from a quarter mile to a half mile away from the old ones, so that both cannot be attacked simultaneously. Every known safeguard against bombing and sabotage will be built into them, from the foundation up.

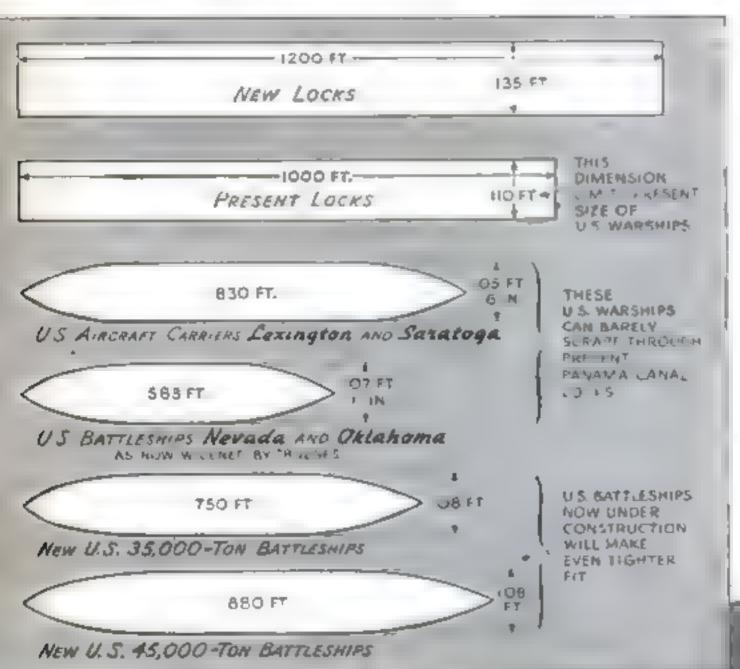
Secondly, the enormous size of the new locks, 1,200 feet long and 135 feet wide, will comfortably accommodate the biggest men-of-war and ocean liners affoat or contemplated. Widened by recent addition of antitorpedo bulges, some of our modernized

battleships can barely scrape through the old locks, with only a foot to spare on each side! Our giant aircraft carriers Lexington and Saratoga make almost as tight a fit. Until now, the 110-foot width of the existing locks has limited the dimensions of all U.S. warships, including the 35,000-ton and 45,000-ton battleships now under construction. As for the big merchant vessels, the Queen Elizabeth, the Queen Mary, and the Normandis, they could not squeeze into the old locks at all. The projected locks will have plenty of room for all comers.

Thirdly, the sheer volume of peacetime traffic through the Panama Canal, steadily rising through the years, will eventually call

> for more locks to handle it. From this standpoint alone, the Governor of the Panama, Canal recently declared, the thirdle k project should be started within nine to eleven years. Present plans simply advance the date for completion of an outstanding national asset, both in war and in peace.

Connecting with the present waterway several miles above and below the existing locks, "ty-pass" or approach channels will lead to the new locks, so that canal traffic may be shunted through either set. Criss crossing routes



MAKING THE CANAL FIT MODERN SHIPS

The drawing above illustrates how the design of our warships has been restricted by the size of the present Panama locks, and how the larger locks will permit the building of bigger and more powerful naval vessels. Three liners, the "Normandie," "Queen Mary" and "Queen Elizabeth" are too big for present locks





The present two-lane Gatun Lacks. The new locks connected to the canal through "bypass" channes, will be a half mile away Below, a treighter prows through Gaileard Cut



will enable a ship to be detoured around locks that may be out of commission.

Starting from the Pacific, for example, a vessel may pass through either the old or new Miraflores Locks, which raise it in two lifts to Miraflores Lake. The old and new single-flight Pedro Miguel Locks then offer

alternate gateways into Gaillard Cut, the artificial arm of Gatun Lake formerly known as Culebra Cut. Separate channels from broad Gatun Lake allow the ship to be routed through either the old or new three-flight Gatun Locks for its descent to the Atlantic

Favorable sites for the new locks and their channels were found by a preliminary survey in the field. With core drills, engineers brought up samples of subsurface rock, to make sure of a substantial foundation for the massive concrete lock chambers. Artificial earthquakes, produced by setting off explosives, proved the rock formations free of faults. Investigations showed that the present water supply would amply suffice for both the old and new lock systems.

Actual work on the third-lock system will begin at once, with initial funds of \$114,000,000 just voted by Congress. As the huge project gets under way, whole new towns will spring up at construction centers. First steps include

building roads, relocating railways, and excavating the locks sites and approach channets, which total about ten miles in length. Then will come the building of the giant locks themselves. Fast-moving world events may call for drastic speed-up measures to hasten the mighty engineering feat.

FLYERS BY THE TEN

JOHN E.

HEN you walk across a campus these days, you are quite as likely to hear undergraduates talking knowingly about low-wing monoplanes, wing-overs, and cross-wind landings as you are to hear them discussing mouse-trap plays, heavy dates, or passing marks. The Civil Aeronautics Authority's bold and auccessful venture

dates, or passing marks. The Civil Aeronautics Authority's bold and auccessful venture of training youthful flyers by the thousands has made John College and Jane Coed go sirminded. Don't think that these collegiate aviation talkers are mere "hangar pilots." Most of them are flyers, or are well on the way to becoming flyers. During the college year of 1939-40 about 9,000 of them, enrolled in 437 colleges located in every state and in the District of Columbia, Alaska, Hawaii, and Puerto Rico, earned their private-pilot licenses. In addition, well over 700 noncollegians, winners of competitive flight acholarships offered the students in seventy ground courses sponsored by civic organizations in every state and in the District of Columbia and Alaska, are receiving exactly the same training.

College students learning about airplane engines as part of the ground-school training in the Civil Aeronautics Authority program

Training Program in Colleges To Provide Huge Army of Pilots for Uncle Sam

NIS.



THOUSAND

When this nation-wide training effort was started last fall, its primary objective was to accelerate the already swift progress of civil aviation in the United States by teaching large numbers of young men and women to handle their own airplanes safely in either pleasure or utility flying. A secondary objective was the building up of a reserve of physically sound, partially trained pilots for possible service in the Army or Navy in the event of war.

The swift and menacing march of world events in the past few months has brought about a re-

versal in the degree of importance placed on these objectives. Now most of the emphasis is on the national-defense aspect of the program, which has been greatly expanded. In the course of the coming year the C.A.A. courses will give ground and primary flying training of 45,000 students in three intensive courses, each of which. instead of being spread over the school year, will be compressed into four months. In addition, the 9,000 1940 graduates—over ninety percent of them have indicated their desire to become military flyers-will be given forty-five-hour advanced courses in faster planes than those which are used for the primary training.

The Civil Aeronautics Authority, the Government agency charged with the regulation of civilian aviation, has no direct connection with the armed services. The graduates of its flying courses are not combat flyers, and have no military obligations which are not shared by nonflyers of the same age. But the training they receive is the equivalent of the flying training given Army and Navy flying candidates, and it will enable many of them to qualify as com-



Girls are eligible, too, and many of them already have qualified for their private pilots' licenses

bat fiyers after six months of advanced specialized training in service flying schools.

When the project of providing wholesale flight instruction first was considered late in 1938, an abnormally high percentage of student-fiyer accidents was helping to make private flying, with a safety rate of only 750,000 miles for each fatality, the most hazardous form of aviation. But careful investigation indicated a method by which mass production of pilots might be achieved with a high degree of safety. It was found that the students of flying schools which had thorough ground courses and sound flight courses suffered far fewer fatalities than did the graduates of schools whose instruction standards were lower.

Placing heavy emphasis on safety, C.A.A. experts worked out a ground course which

would teach students why and how airplanes fly, and a flight course which would enable instructors to nip bad flying habits in the bud. In the spring of 1939, with \$100,000 of National Youth Administration funds, a test program was started in thirteen selected colleges. Undergraduates enthusiastically grabbed at the chance to learn to fly—so enthusi-

A campus flyer cames in for a landing. The flight training is given by plane operators at near-by airports





In a flying classroom students from the University of Miami. Fla., listen in with earphones to the rad o-beacon signals and watch the instrument panel while scaring 7 000 feet above the earth

astically that at the University of Alabama there were 1,200 applicants for the thirty places in the class. A total of 330 students with high physical qualifications were accepted at the thirteen participating colleges. All of them reached the solo stage and 317 won private-pilot licenses. Their average flying time to the certificated stage was thirty-eight hours, and they flew a total of 1,200,000 miles with only a single fatality.

Convinced by this experience that the way
to increase the safety
of flight instruction was
to raise the quality of
the instruction, the
C A A, standardized its
ground and flying
courses and required all
airmen holding flightinstructor ratings to
familiarize themselves

An Instructor explains the working of the tail surface of a plane. The thorough ground training has produced a remarkable record for safety with the improved instruction methods and to pass an examination to prove that they had done so. More than 4,000 instructors passed the test, assuring the Authority of plenty of highly-qualified teachers for its training program.

Congress passed a Civilian Pilot Training Act and provided \$4,000,000 for the 1939-40 courses. Undergraduate interest was so keen that colleges ranging from stately ivy-



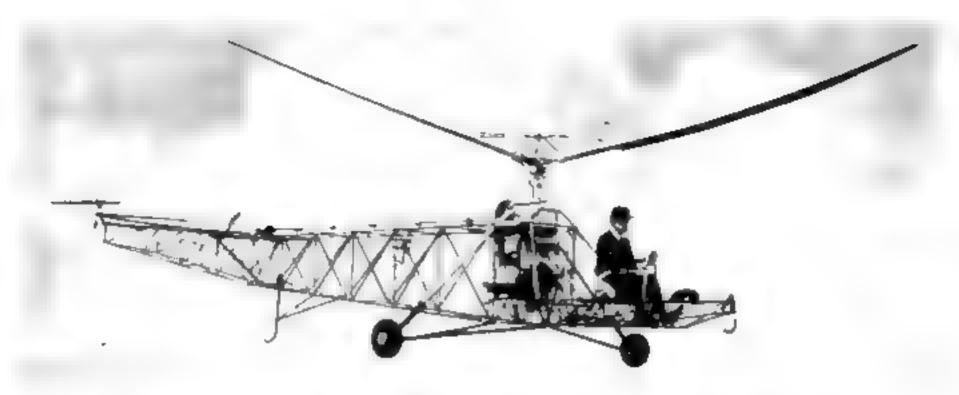
covered institutions to little city and junior colleges offered the pilot-training courses.

When school opened last September, over 9,300 undergraduates who had passed the searching physical examinations given by C.A.A. flight surgeons were accepted as students. By June they had logged 310,000 dual and solo flying hours-almost 22,000,-000 miles-with very few mishaps and only one fatality. That remarkable record is an improvement of 3,700 percent over the safety record for flight training for the

whole country only a year ago! Under the terms of the Civilian Pilot Training Act at least five percent of those enrolled for the courses must be noncollege students. To provide instruction

services. American Legion posts, aeronautical associations, and civic clubs in communities of every state. The ground courses, which are exactly the same as those offered in the colleges, are open to anyone, but, to be eligible for one of the ten flight scholarships offered with each course, the student must pass the same physical examination given the col- (Continued on page 219)





Helicopter Flown Successfully

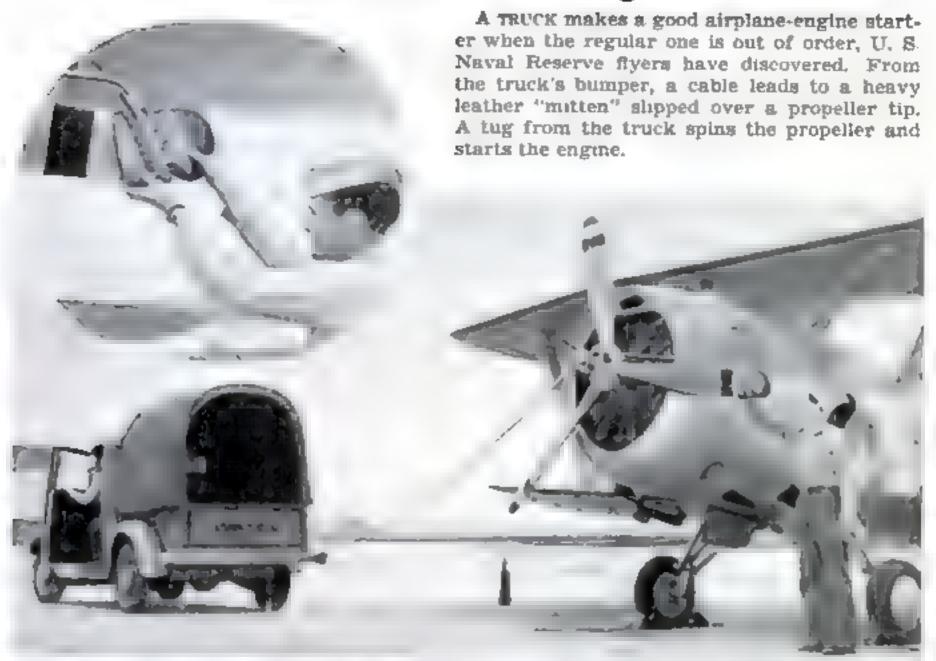
WHAT is claimed to be the first successfully controlled vertical flight in a heavier-than-air machine was made recently by Ivor Sikorsky, prominent aeronautical engineer, at Bridgeport, Conn., in his new helicopter. Powered by a seventy-horse-power engine and equipped with variable-

pitch rotor blades, the craft moved straight up from the ground for thirty feet, circled the field, and then settled vertically to the ground. Small rotor blades mounted on the bare fuselage of the craft act as elevators and rudder. Sikorsky is shown at the controls of the helicopter in the photographs.

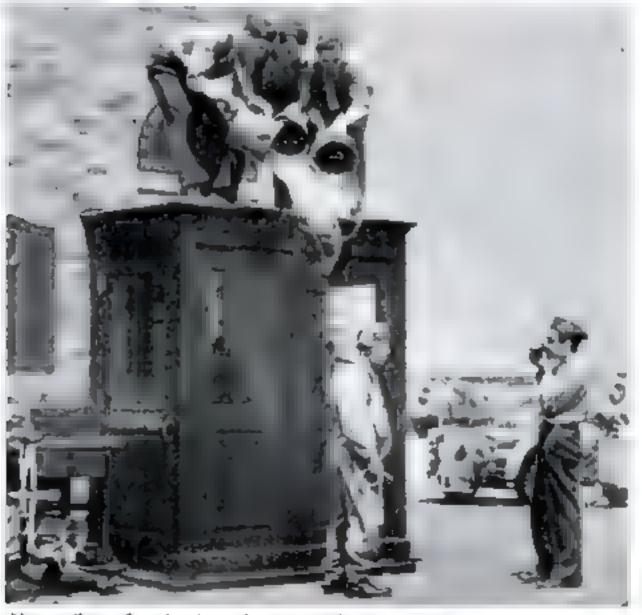


Ivor Sixorsky about to take off on a test flight in his helicopter. At top, the odd machine in the air

Truck Serves as Plane-Engine Starter



All set to spin the motor on a Naval Reserve plane. Inset shows "mitten" being placed on propeller tip



Navy pilots often land on the water. This time it's the other way around

Baptism Marks Graduation of Naval Flyers

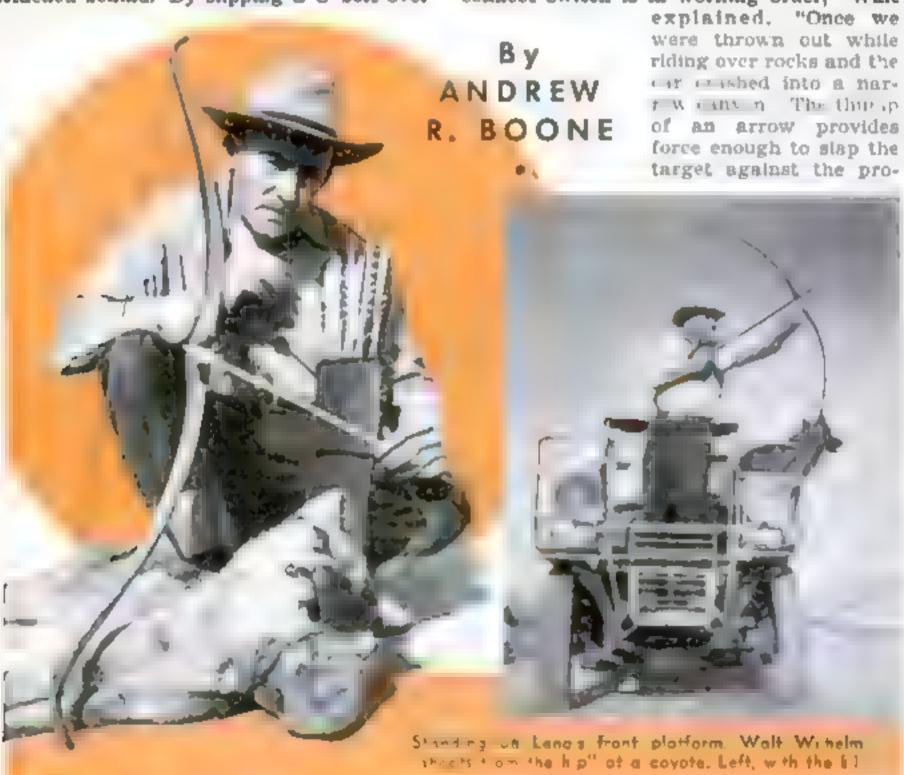
HE's learned to fly for the Navy-and now three bucketfuls of water, symbolizing the Navy's domain, initiate this proud fledgling into the ranks of his fellow airmen at Floyd Bennett Field. New York City. Scarcely less than an official decoration, he will treasure the picture of the traditional ducking that a friend is about to snap. Sometimes, instead of getting a shower, a new pilot may receive the rare honor of being tossed off the pier. The Navy birdmen say there is little to choose between the soakings.

BOW-AND-ARROW HUNTERS RIDE DESERT JALLOPIES

Steep embankments, plunging down gullies, two mechanical mountain goats, created from automobile odds and ends, carry Walt and Ken Wilhelm, of Yermo, Calif., on daring expeditions into the Mohave Desert. Aboard these remarkable vehicles, called Lens and Prowler, the two brothers chase jack rabbits, rope coyotes, hunt game with bows and arrows, explore remote corners of the desert, search for fossils, trail outlaws, and rescue lost travelers.

They think nothing of starting Lena or Prowler across the desert, leaping out and riding lickety-split over cactus and across the frequent washes on sleighs or toboggans attached behind. By slipping a U bolt over a spoke of the steering wheel, either car can be directed in a straight line or a wide circle. Sand banks and bowlders offer no obstacles to the huge tires. Near Yermo, I once watched Prowier roaring driverless around a circle nearly two miles wide. The car plunged down narrow guilles, slithered through sand, overrode needle-pointed cactus spines, returning in ten minutes to our side.

When the car approached, both men fitted blunt arrows to their bows, and as it passed Walt fired quickly at a large rice-straw target slung behind the back seat. As the broad-head struck the bullseye, the automobile motor stopped dead and the car coasted to a halt, "We never go out unless the disconnect switch is in working order," Walt





greasewood on a flat mesa. Noting the car approaching near-by badlands, Ken prepared to loose an arrow, but his bow broke

"What happened to the car?" I inquired.

"She's still there—a mess of junk." That was loss number one. A few months later, while playing around the treacherous potholes of Soda Sink, Walt felt the tires sinking. Leaping to

the soft earth, Ken and he rolled half a city block to hard ground. When they returned thirty minutes later with timbers, the car had disappeared in quicksand.

Both Ken and Walt will tell you they assembled their unique desert cars for the thrill

of bumping along off the beaten path. That is the truth but not the whole truth. Both brothers are enthusiastic archers. In the desert, they are able to practice incessantly, now abooting at a bounding jack rabbit, again loosing arrows at an artificial deer

Walt springs to a safer seat, and the sturdy con-

traption plaws straight off the edge of the hill

AUTOMATIC CUT-OFF, DESERT STYLE

In case the boys are thrown by a bump, an acrow shot against the target stops the vehicle. With the wheel clamped [below], it trovals in any fixed circle. The siren is a cayote "decay"



which Walt built not long ago. Driven by a gasoline motor and eccentric gear, it jumps up and down in the brush exactly like its prototype. So expert has their desert practice made them that last summer Ken set a new world's record for distance shooting. He is the first man in al. history officially to send an arrow farther than half a mile

For nearly twenty years, the Wilhelms have been exploring the

Mohave in various kinds of vehicles. Gradually, they evolved their present cara. You could buy the parts for either Lena or Prowler at a junk yard for \$200 or so. But you'd work six months putting them together. It took the brothers exactly twenty-four days merely to fasten the tires to the rims. They started with huge, twelve-ply truck tires. Boots, countersunk and held firmly over blow-out holes by carriage bolts, went in ahead of the tubes. Using hydraulic jacks. they struggled until they pushed the thick beads onto the narrow rims of twenty-inch wheels. So tightly are the beads wedged that flats never bother them. "The tire walls are very strong," Walt explained. "They'll carry us anywhere; and by forcing the tires on narrow rims, we anchored them so they can't turn and tear the valves out."

In each of the machines, they installed two gear boxes, giving them many speeds forward and in reverse, too. Carrying only eight pounds of air in the tires, they can push up a steep, rocky hill with the engine turning fifty revolutions to one of the rear wheels, or they can speed along the smooth high-

way at a two-to-one ratio. The big tires take up most of the shock in rough going "You oughts see Ken when he's in a burry," Walt told me. "He'll jump straight off an embankment, going fast enough to land on his wheels."

Sometimes, but not always. Once, Ken tried this stunt while chasing a coyote, and straddled a hillock, breaking the motor block in half. After walking eleven miles for help, he decided to armor-plate the motor. Now, both Lena and Prowler are protected by a heavy sheet of boiler-plate, bolted against a cushion of wood beneath the pan of each engine.

Another time, the Wilhelms were grinding cross-country in Nevada, fifty miles from the nearest crossroads, when the welds holding a disk wheel to the flanges broke under the pounding vibration. Should they try to repair the damage, or walk three days for help? Walt took down their .30/06 rifle and shot three holes through the disk to form an approximate triangle. Next, he shot three holes in the flanges, outlining a similar triangle. Finally, they bolted the wheel back into place and drove slowly to a distant mine. Here, using salt and fine sand as a flux, they brazed the metals tightly with the metal from used rifle shells.

pair and their desert cars have been pressed into service by the local sheriff for hunting outlaws, and on other occasions they have headed into the Mohave on errands of mercy. The most spectacular of these trips was a sixtymile journey through snow and over two mountains, carrying food to a dozen starving miners. As an aid to keeping in touch with each other when roaming through desert wastes, the brothers recently added the latest pieces of equipment carried by Lens and Prowler: a pair of midget short-wave radio sets. If either brother is in difficulties, he can send out an SOS with the assurance that the other machine will soon put in an appearance, taking guillies and rocks in its stride.

On several occasions, the adventurous

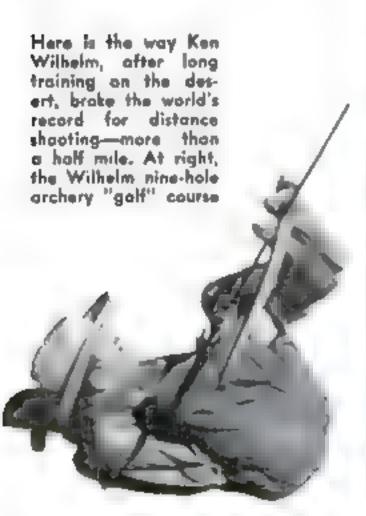
When the going gets really tough and there is obviously danger of Lena or Prowler sliding down a hillside to disaster, the boys halt. But not for long.



This mechanical deer bounds across the plains realistically, providing excellent bow-and-arrow practice

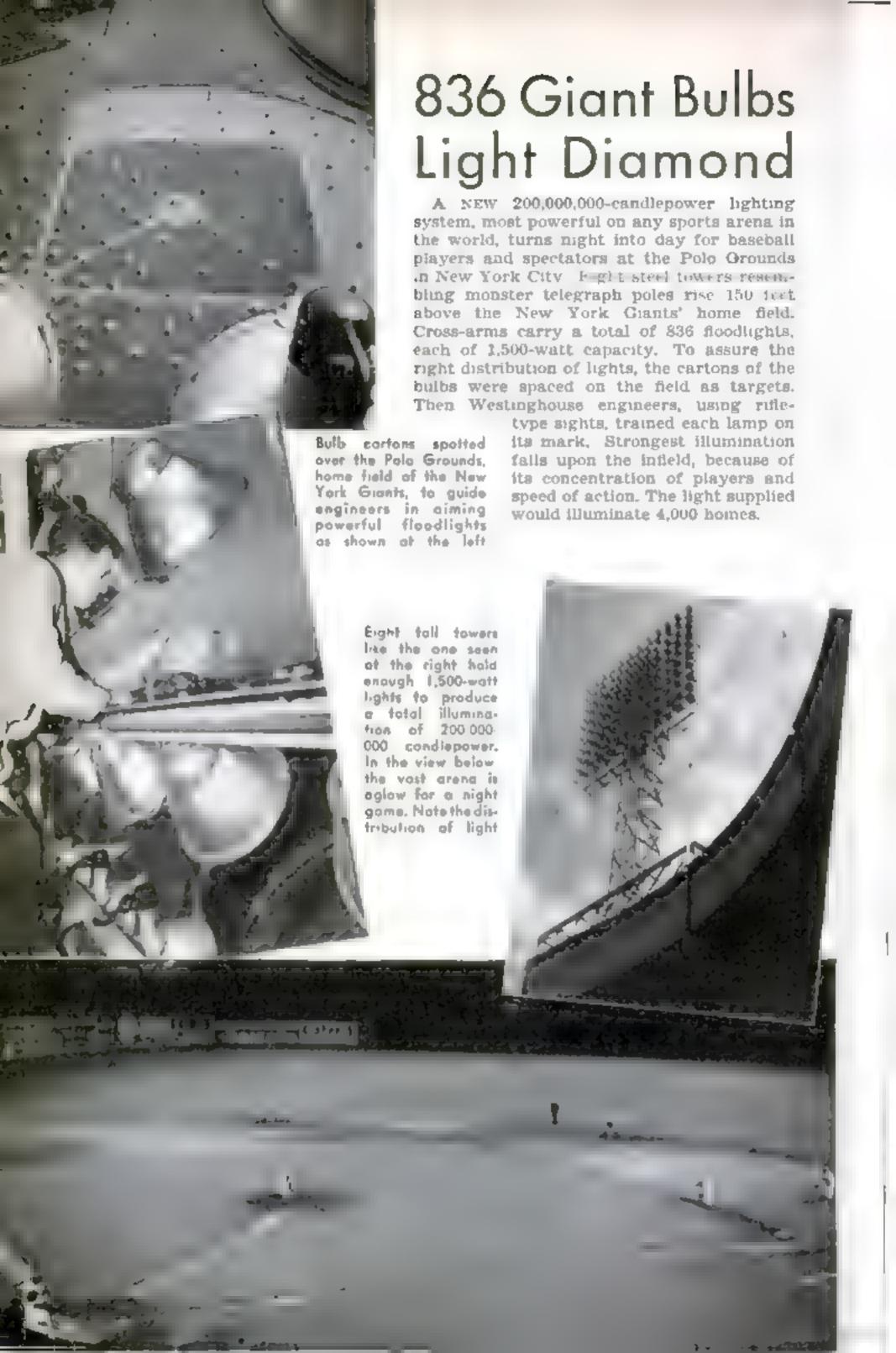
Selecting two straws—one longer than the other, they draw lots. The one "winning" the draw takes over the wheel and drives.

Climbing a steep mountain one morning, they approached a sharp switchback. Out came the straws. Ken won. Before they got out of their fix, it was sunset. Yet they set out for more sport like it next day.



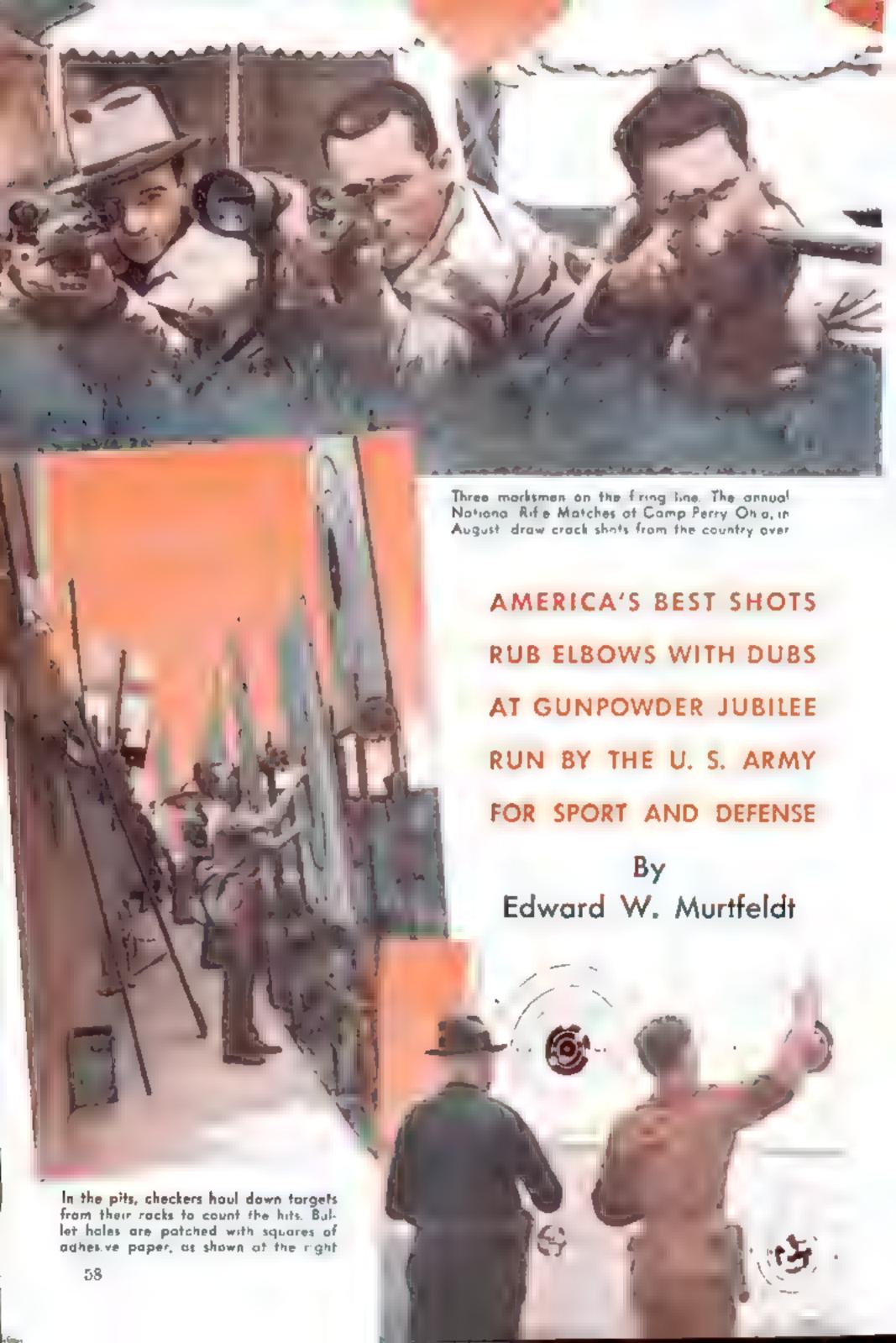


SPORTS









PRAVELING in planes, trains, buses, private cars, trucks, and even on foot, more than 10,000 eager men, women, and youngsters from all corners of the nation will head toward the shores of Lake Erie in mid-August for the largest sporting event in the world. The lure that draws this myriad of bankers, housewives, G-men, clerks, police, shopkeepers, and citizens from practically every other walk of life, is the annual National Rifle Matches sponsored jointly by the U. S. War Department and the National Rifle Association

In this mammoth gunpowder rodeo, millions of rounds of ammunition will be fired from pistols, .30 caliber rifles, and small-bore guns. Police will school themselves in getting the jump on criminals. Hundreds of beginners will learn how to shoot and how to handle guns safely. Marksmanship records will be assaulted, historic trophies won, and national champions crowned. And at the end of the three-week bullet jubilee, a new group of straight-shooting citizens will scatter to their homes to add to the defensive power of the nation and to the world-wide reputation of the United States as a country of crack shots.

The shooting starts August 18 at the

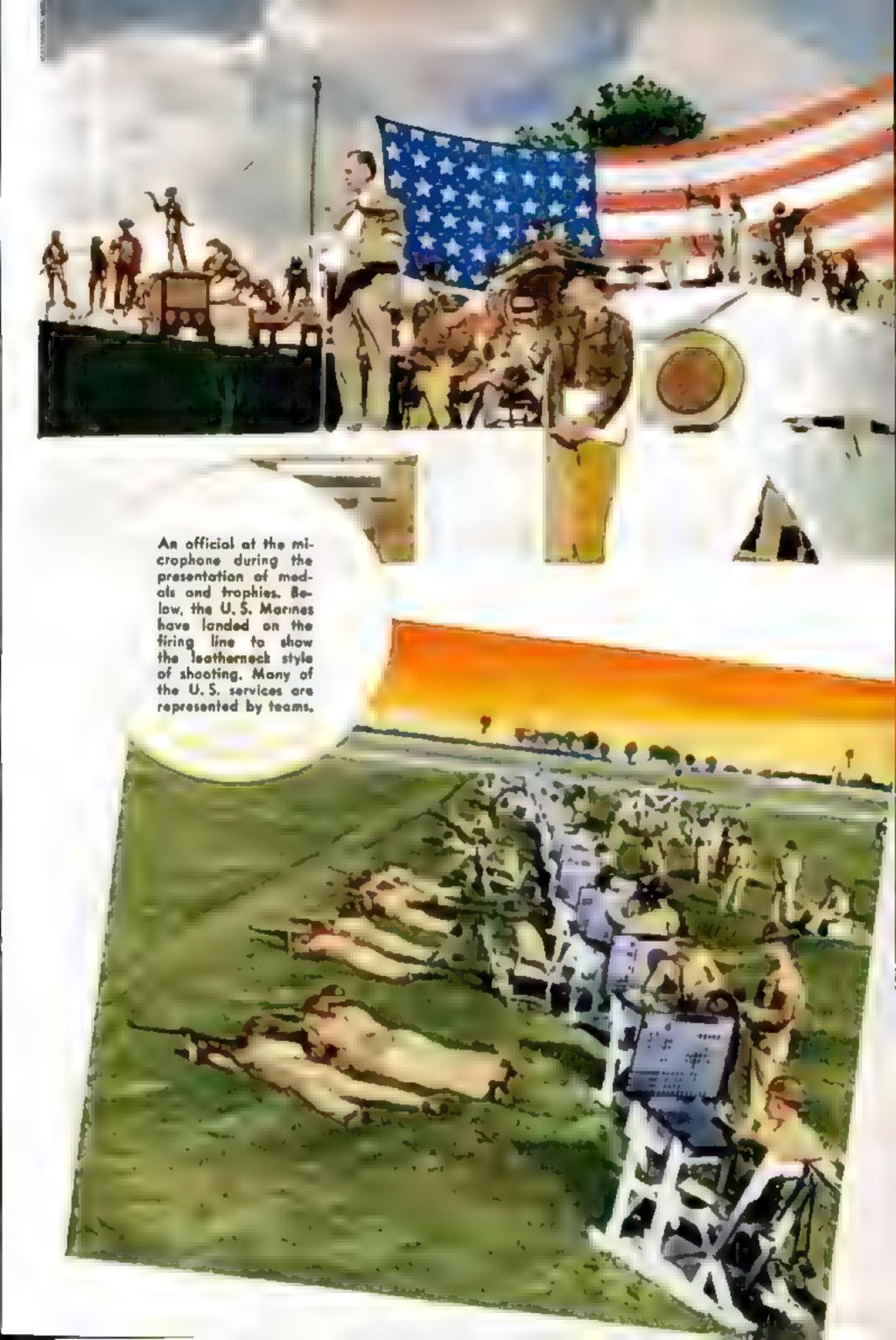
Army's Camp Perry, a few miles from the lake town of Port Clinton, Ohio. Nowhere else in the world, experts state, is there a rifle and pistol range that can compare with it. Here, stretched out side by side for two and a half miles, are target ranges of every size from 1,000 yards for .30 caliber rifle competition to twenty-five yards for pistol events. And around the fringe of the ranges is a far-flung city of tents to house the extensive Army personnel required to run the matches, and also to accommodate practically all the contestants and visitors.

For the matches are open to any citizen of the United States, and the Army will put up any American who wants to compete. Tents, beds, and bedding are supplied without charge, while a mammoth cafeteria serves meals at low prices. For the rifle or pistol fan who would like to bring his family, the "Squaw Camp," a part of the reservation next to the bathing beach, is set aside. Here a man and his wife can have a floored, acreened tent, with electricity, for \$1.50 a day. Bringing junior along adds just fifteen cents a day to the tent cost.

And you don't even have to own a gun, for the Army will issue you a .30 caliber rifle, or a .45 caliber pistol, and furnish all







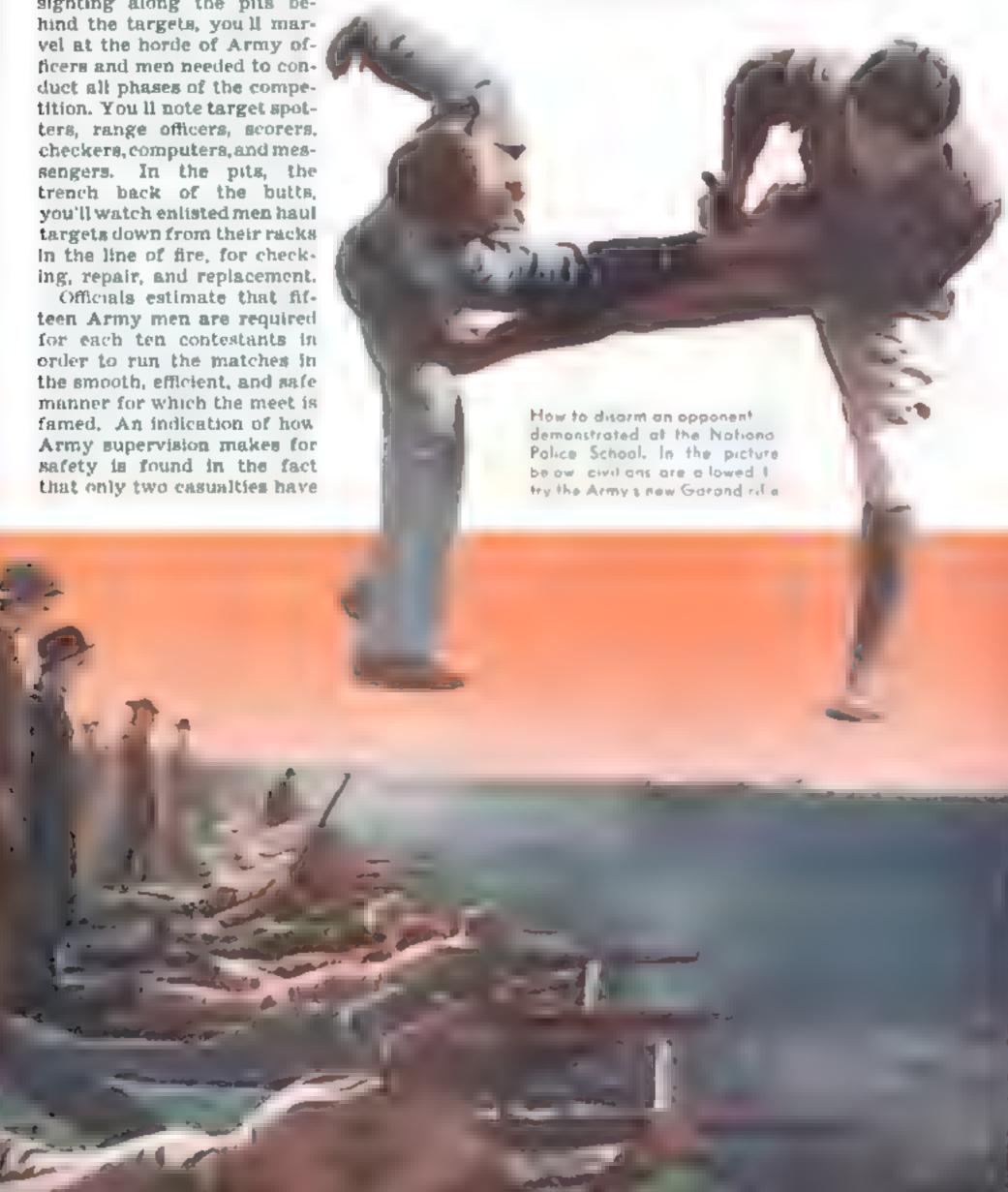
the nation's greatest shots, together with the dubs and rank tyros, are standing, sitting, kneeling, and lying prone, shooting rifles, pistols, and revolvers at various ranges, in timed-fire, rapid-fire, and slow fire matches. Playing a sharpshooter's swing tune, bullets whistle through the air and zing into the targets, or occasionally kick up a spatter as they miss the target and plow into the waters of Lake Erie beyond the butts.

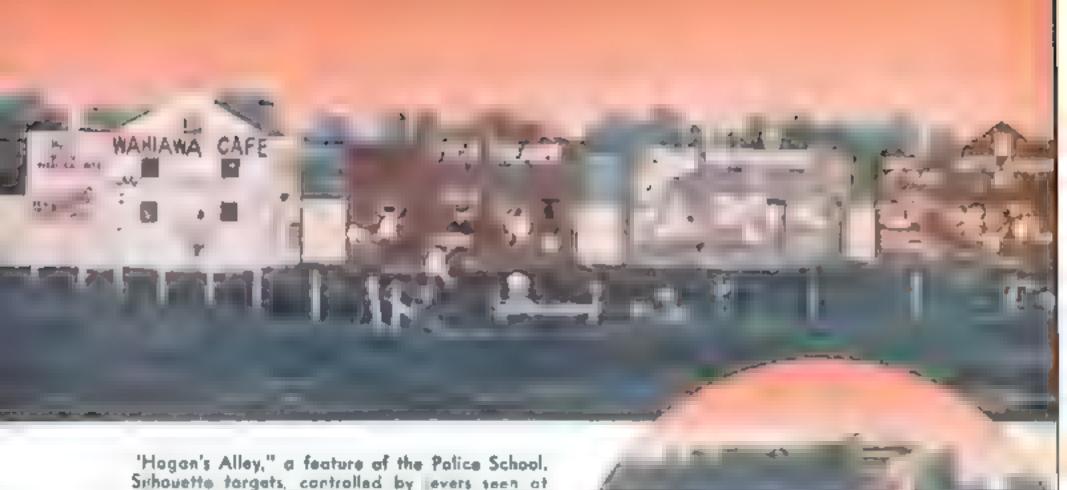
Strolling down back of the firing line, or

sighting along the pits behind the targets, you'll marficers and men needed to conduct all phases of the compecheckers, computers, and mesyou'll watch enlisted men haul targets down from their racks in the line of fire, for checking, repair, and replacement.

occurred in twenty-one years of match firing at Camp Perry

Down at the left of the range, you'll witness one of the most interesting phases of the Perry matches-the National Police School, where representatives from police departments in all sections of the country are schooled in the latest methods of police science, and sent back home as qualified instructors to their fellow officers in the home forces. Subjects studied in the full-week course include disarming an attacker, shoot-





ing at rapidly disappearing targets, using tear gas and the Thompson submachine gun, hand-to-hand fighting, and the fundamentals of jujutsu.

right, appear in windows of the dummy buildings.

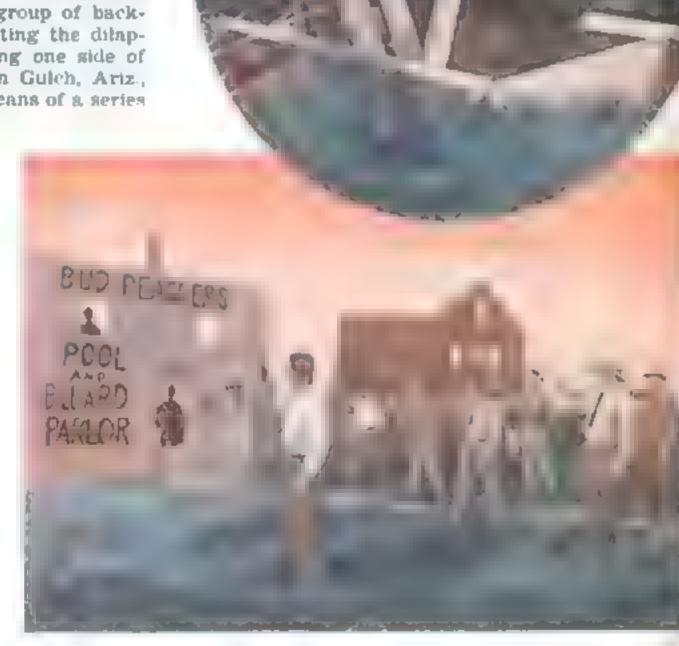
Here at the Police School is the famous "Hogan's Alley," a curious group of back-less building fronts representing the dilapidated frame structures lining one side of the main street of Bucktown Guich, Ariz, as it appeared in 1879. By means of a series

of hand levers and attached cables, silhouette figures are popped suddenly into the window or door openings of "Bud Peagier's Pool Parlor," or the "Wahiawa Cafe," while police try to drill them with pistol bullets before they disappear two seconds later.

Near-by is a replica of the rear of an automobile Traveling on an overhead trolley, it speeds away as police fire at it in attempts to "blow" a rear tire. Simnar in operation is a running-man target, which crosses the officers' line of fire at an angle from left to right.

The value of this police training is dramatically revealed by the experience of the Detroit, Mich., police who have sent representatives to the school for years. When they first

started, an average of four policemen lost their lives for every criminal killed in Detroit, Today, the average is one policeman to every eleven criminals.



A hot gun battle in the Alley. Since the targets appear unexpectedly and vanish in two seconds, it takes good shooting to hit one

At the opposite end of the range from the Police School you run across hundreds of youngsters from eight to eighteen, some of whom will shoot it out for the national junfor championship of the nation, and some of whom are barely big enough to hoist a rifle to their shoulders. A U. S. Marine is assigned to each of these neophytes to give him expert instruction in the rudiments of rifle shooting and gun handling. Before the youngster comes out from under the wing of his leatherneck guide, he will have learned not only how to shoot a gun and handle it safely, but also how to clean it, take it apart, and put it back together again.

Truly a giant training ground for the de-

velopment of the art of shooting, in all its phases from the instruction of future sharp-shooters to the rewarding of record-breaking feats of marksmanship, the annual Camp Perry meet has had much to do with the establishment of shooting as one of the most popular American sports. And now, with national defense of primary importance, Perry's influence may prove to have been of even greater value than that of a clean, wholesome sport in building up the armed might of the United States.



Fishing Boat Steered from Crow's Nest



When the lookout sights a school of fish, he can run the vessel toward it by controls atop the most

ONE man can act both as pilot and lookout aboard the fishing boat Santa Lucia of Santa Barbara, Calif. In the crow's nest of the vessel, two control wheels are connected

by means of long rods with the steering mechanism and engine below. The pilot can thus steer his craft toward any school of fish he sights from his lookout.

Motor Conversion Unit for Bicycles



verted into motorized vehicles by means of easily installed units just introduced. The rear wheel of the bicycle is removed and replaced by the unit pictured at the left, which includes an engine, drive mechanism, small rear wheel, and special luggage compartment. Rated at one and a half horsepower, the four-cycle, air-cooled motor is equipped with a kicktype starter and drives the wheel at speeds up to thirty miles an hour, running more than 100

Bicycles can be con-

miles on one gallon of gasoline. Power is transmitted to the rear wheel by means of a specially designed drive incorporating a chain and V-bett transmission to reduce road shock and vibration. Clutch and throttle are operated by finger-tip controls on the handlebars.

Trap on Gun Hurls Clay Targets

WEIGHING only fourteen ounces and clamping to the barrel of almost any .22 caliber smoothbore or .410 shotgun, a simple spring trap for throwing small clay targets makes possible an exciting new shooting game. The forefinger of the left hand presses the target release, sending the clay disk skimming away, while the foreinger of the right hand operates the trigger of the gun. At a distance of fifty feet the tiny pellets of a .22 long rifle shot shell will break one of the clay disks. According to the inventor, I. O. Mossberg, of New Haven, Conn., such one-man trap shooting can be practiced safely in any 300-foot open field, since the range of the shot is short

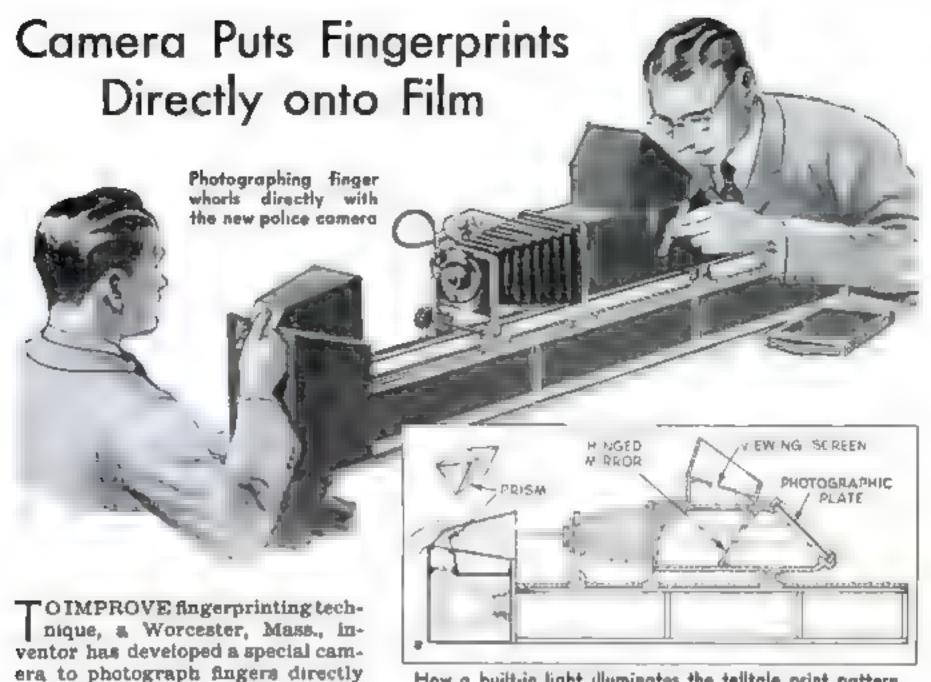




Any open field becomes a trap-shooting range with this new game for sportsmen. Above, how the trap is attached to the gun barrel and scatter-shot shells used with a .22 caliber smoothbore. Trap spring can be adjusted for speed and distance, as illustrated at left

SPORTS

POPULAR SCIENCE



built-in light illuminates the telltale print pattern

a finger against one side of a prism set into one end of the apparatus. Light from an electric bulb in a special housing shines into the prism and reflects the finger image through the lens of an adjustable reflex-type

camera for focusing and photographing, Side lighting brings out details of the print clearly, while by eliminating the need for an inking pad, the apparatus removes the danger of ameared prints.

Bank Teller's Cage Has Fourteen Ways To Foil Holdups

to obtain prints. The subject places

No MATTER what tactics a robber may attempt, the teller in the special bank cage pictured at the right has a card up his sleeve to foil him. Installed in the demonstration room of a company manufacturing protective devices for banks, stores, warehouses, and other places of business, the cage is equipped with fourteen separate electrical devices, most of which are hidden and capable of secret operation while the teller apparently obeys the orders of his armed "customer." In the photograph, the teller is shown operating an alarm button under the counter with his left hand while handing over cash with his right.



By pressing a concealed button, the cashier gives the alarm



ls It Murder?

By EDWIN TEALE

TFIVE minutes past eleven, on the night of April 18, the crash and rumble of an elevated train muffled the quick double report of a revolver on the upper floor of a New York rooming house. The next morning, a housekeeper found the bodies of a man and woman sprawled on the floor, both shot through the head. Between the two, where it appeared to have dropped from the stiffened fingers of the man, lay a blue-barreled, ,32 caliber revolver. Appar-

How Scientific Sleuths
Uncover Hidden Clews
to Trap Clever Killers
Who Plot "Perfect Crimes"

ently, the tragedy was a murder and suicide.

That is the way the verdict might have stood, but for one of the newest strings to the bow of scientific crime detection. In New York City, as part of their regular procedure, detectives now obtain blood samples at the scene of every crime of violence. In this instance, such samples quickly erased "suicide" from the report and left the one ominous word: "murder."

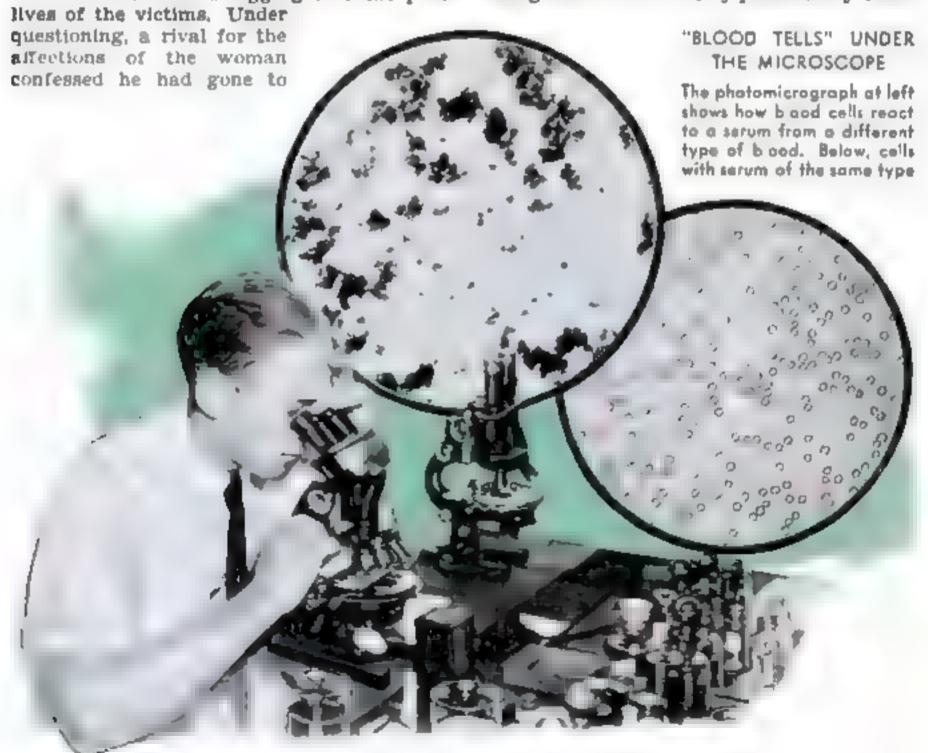
A laboratory detective, skilled in the use of serums, studied the blood samples with test tube and microscope. As a result of recent research at the Rockefeller Institute. and in other laboratories, seventy-two groupings of fresh human blood are now recognized under the four main types: A. B. AB, and O. Through the reaction of specimens and serums, the detective ascertained that the woman had type B blood; the man type A. Samples of small, fresh stains on the floor of the death room, however, gave an entirely different reaction. They had been produced by type O blood and could not have come from the life stream of either victim. A third, unknown, injured person had been in the room on the night of the tragedy!

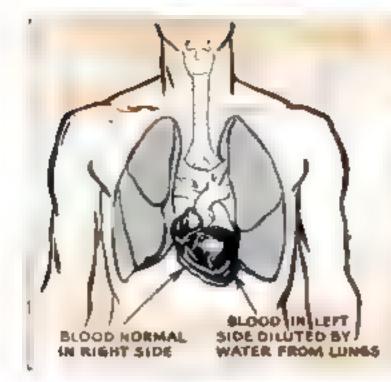
That laboratory clew set detectives of the homicide bureau digging into the past the room, had been slashed in a quarrel, and had shot both the man and woman. Then, after wiping fingerprints from the revolver, he had planted it to suggest a suicide.

Oftentimes, cunning and cold-blooded killers seek to hide their crimes by such a ruse. Exposing these murders disguised as suicides is one of the dramatic jobs of the scientific sleuth.

In this work, present-day crime fighters are making use of many of the resources of science. They are putting paper, hair, rope, handwriting, fingerprints through a scientific third degree. They are employing spectroscopes to reveal the presence of metals and drugs. They are using polarized light to make crystal patterns stand out vividly under the magnifying lens. They are operating comparison microscopes to bring the images of two bullets or bits of metal together so that scratches can be compared. In some instances, the reaction of chemicals placed on a victim's hand has proved he did not fire the weapon he held. In other cases, a comparison of revolver-barrel markings on bullets showed that the victim was killed by another pistol rather than the one found clutched in his hand.

The old expression, "Blood will tell!" has been given a new twist by present-day crim-





DID DROWNING OCCUR IN SALT WATER?

By comparing the amount of soft in the blood in right and left sides of the heart, scientific detectives can determine whether a drowning victim died in fresh or salt water. This test often unmosks criminals who have "planted" a body in order to counterfeit a suicide

crowded street below to hide his crime.

One of the most ingenious advances in recent criminology is a blood test devised by the noted New York toxicologist, Dr. Alexander O. Gettler. It tells almost infallibly whether a drowning victim met his death in salt or fresh water. From the lungs, blood goes directly to the left side of the heart where it is pumped through the circulation system

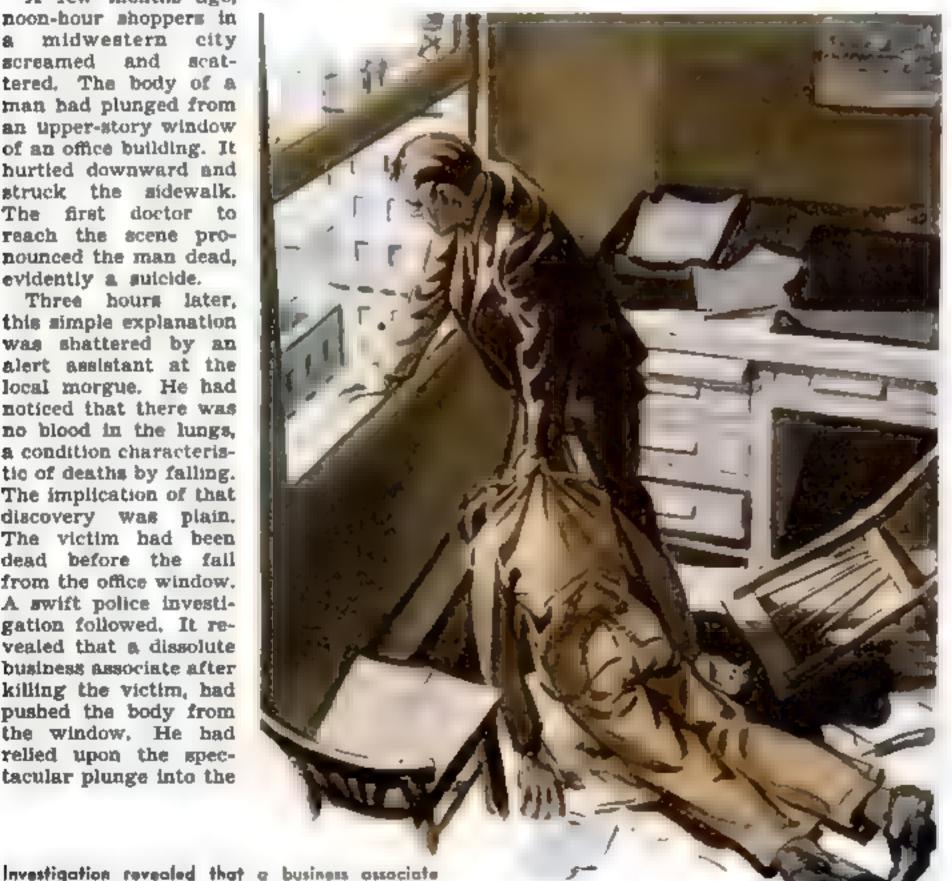
of the body, returning to the right side of the heart. Normally, this blood contains a certain percentage of salt. When drowning occurs in sea water, the lungs fill with brine

inology in unraveling mysteries of simulated suicide. Even the tiniest drop of this vital fluid is often enough to reveal important clews that will lead to a solution.

A few months ago, noon-hour shoppers in midwestern city screamed and acattered. The body of a man had plunged from an upper-story window of an office building. It hurtled downward and struck the aidewalk. The first doctor to reach the scene pronounced the man dead, evidently a suicide.

Three hours later, this simple explanation was shattered by an alert assistant at the local morgue. He had noticed that there was no blood in the lungs. a condition characteristic of deaths by falling. The implication of that discovery was plain. The victim had been dead before the fall from the office window. A swift police investigation followed. It revealed that a dissolute business associate after killing the victim, had pushed the body from the window. He bad relied upon the spectacular plunge into the

tilled the man and threw his body from the window



before death takes place and the salt content of the blood on the left side of the heart is increased. When death occurs in fresh water, this blood is diluted and so contains less than the normal amount of salt. Simply by taking samples from both sides of the heart and determining the salt content of each, the scientific sleuth now can prove instantly, in suspicious cases, whether death occurred in salt or fresh water. In other drowning cases, microscopic water-borne clews have been instrumental in spotlighting murder plots disguised as suicides.

OR example, a few years ago, boys out hunting gophers entered an old barn standing in a hayfield near a river. Within, they found the body of an elderly man hanging from a crossbeam. All evidence pointed toward a suicide until a scientific detective set to work with his microscope. Beneath the victim's finger nails and in his lungs, he discovered diatoms, or subvisible algae found in fresh-water streams and ponds. This clew—too small for human eyes to see—provided a key that unlocked the

mystery of an amazing murder. The elderly victim had been drowned. Then his clothes had been changed and his body hanged in the barn in what his slayers imagined was a complete obliteration of all evidences of their guilt.

Sometimes the microscope joins forces with the test tube in exposing a suicide slaying. In Ohio, not long ago, a woman was found dead, poisoned by arsenic. Her husband contended that she had taken her own life, and exhibited a half-empty box of vermin eradicator which he said she had used. About this time, evidence came to light that, a week before, he had purchased a different type of this same deadly poison. Had the victim met her death by taking the rat poison, as he said, or had he murdered her with the arsenic be had bought? The anawer hinged on tiny crystals found in the stomach of the victim. The test tube proved they were arsenic. Under polarized light, the microscope next revealed brilliant, triangular facets entirely different from those in the vermin compound. Tripped up in his story, and confronted with this evidence, the slayer confessed.

In the drug-crazed mind of an eastern dentist, some years ago, there hatched one of the most diabolical poison plots in the annals of premeditated murder. His father-in-law had taken out life insurance in his favor. To collect this money, the dentist pretended to fill a large cavity in one of the older man's teeth. Packing it full of the



To collect insurance, a dentist filled a cavity with a deadly poison, covering it with a temporary wax coating

deadly drug aconite, he covered it with a thin, temporary filling. During the night, this filling dissolved and the victim died in agony before morning. The indication, as the murderer expected, was that the dead man had taken his own life. In analyzing the stomach content, however, a toxicologist discovered minute fragments of undissolved dental wax. Suspicious, he instituted an investigation. It resulted in the slayer's conviction.

To save precious minutes in dealing with Borgia killers, scientific detectives in several large cities now employ spectroscopes to analyze unknown poisons. In a fraction the time required for chemical tests, such mechanisms enable them to determine the drug that caused death. In the spectroscope, each chemical element produces its own distinctive lines of color.

N ADDITION to spectroscopes, to polarized light, to the more elaborate tools of scientific crime detection, the investigator on the trail of a fake-suicide slayer often has to devise original apparatus of his own to prove his point. An outstanding instance of the kind occurred during the celebrated "phantom will" case at Ladysmith, Wis.

Shortly after a wealthy widow remarried, she died of poison. Her husband brought forth one of the strangest documents ever offered as evidence in a law court—a combined suicide note and will which had been written neither (Continued on page 221)

Canine Stable Boy Helps Train Racer

High-strung, temperamental race horses often have mascots, whose playful companionship provides a diversion from the serious business of winning turf events Witness, for example, the friendship of Baranca, a thoroughbred, and Flash, a pure-white dog. In the circle at the right, the



Flash, the dag moscot, leading Baranca out for a walk. In the circle at upper right, the race horse is accepting a correct from his canine friend

trained mascot offers the racer a juncy carrot, and at left, he holds the halter and leads Baranca out for a light workout, at their Inglewood, Calif., home. Winner of his share of races, the horse could lead the dog a merry chase if he chose to set the pace instead of meckly obeying the "orders" of his affectionate canine trainer.

Pioneer "Seeing Eye" Dog Is Preserved

ALMO, said to have been the first police dog brought to this country as s, "seeing eye" for the blind, has been preserved as in life for his master. Dr. W. A. Christensen, of Hollywood, Calif. When the animal died, John M. Schleisser, California naturalist, first measured him, both before and after the skin was removed. Next, he modeled Almo in clay, made a cast over the clay, and inside this cast moided a form of papier-maché. Then he fitted the skin, which had been tanned and mothproofed, over the form. Finally he returned the original jawbone and teeth to the mouth. Wearing his harness, as shown a right, Almo now looks as alive as when he trotted across Hollywood street intersections ahead of his master.



ANIMALS

POPULAR SCIENCE



Courage.

Usually, the dogs compete in packs or in braces, which consist of two animals running at the same time. They have from half an hour to three hours in which to cover a given area and find or retrieve game which

speed, stamina, style, intelligence, and

has been released beforehand. The manner in which the dogs handle themselves in the field is the basis of the judges' decision. Centuries of breeding and years of scientific training combine to produce the winners.

The earliest dogs to compete in American field trials were pointers and setters, animals which rigidly point toward game as soon as they scent it. Such contestants are still among the favorites of field-dog fanciers. To watch these hunting dogs in action, I recently drove to Clinton, N. J., where the Jockey Hollow Club was holding one of its celebrated field days for field dogs.

Two black-and-white pointers were zigzagging through the weeds when I drove up to the 1,000-acre, state-owned shooting grounds. In this type of competition, the dogs hunt for pheasants or quail released on the course. At Clinton, the three-mile

a bush-covered hillside, through heavy woods and out onto a lowland meadow cut by a winding stream. Handlers direct the dogs while the judges follow close behind on horseback.

Along the hillside, the black-and-white pointers cut sharply back and forth while the handlers called them in or urged

them out with sharp blasts of their whistles. One blast usually means "Come in!", two blasts "Go on!" To eliminate confusion, handlers often use whistles of different pitch.

While the dogs are working westward through brilliant-hued bushes, the judges are jotting down their notes, watching especially such points as thoroughness and scenting ability. The latter quality is of prime importance.

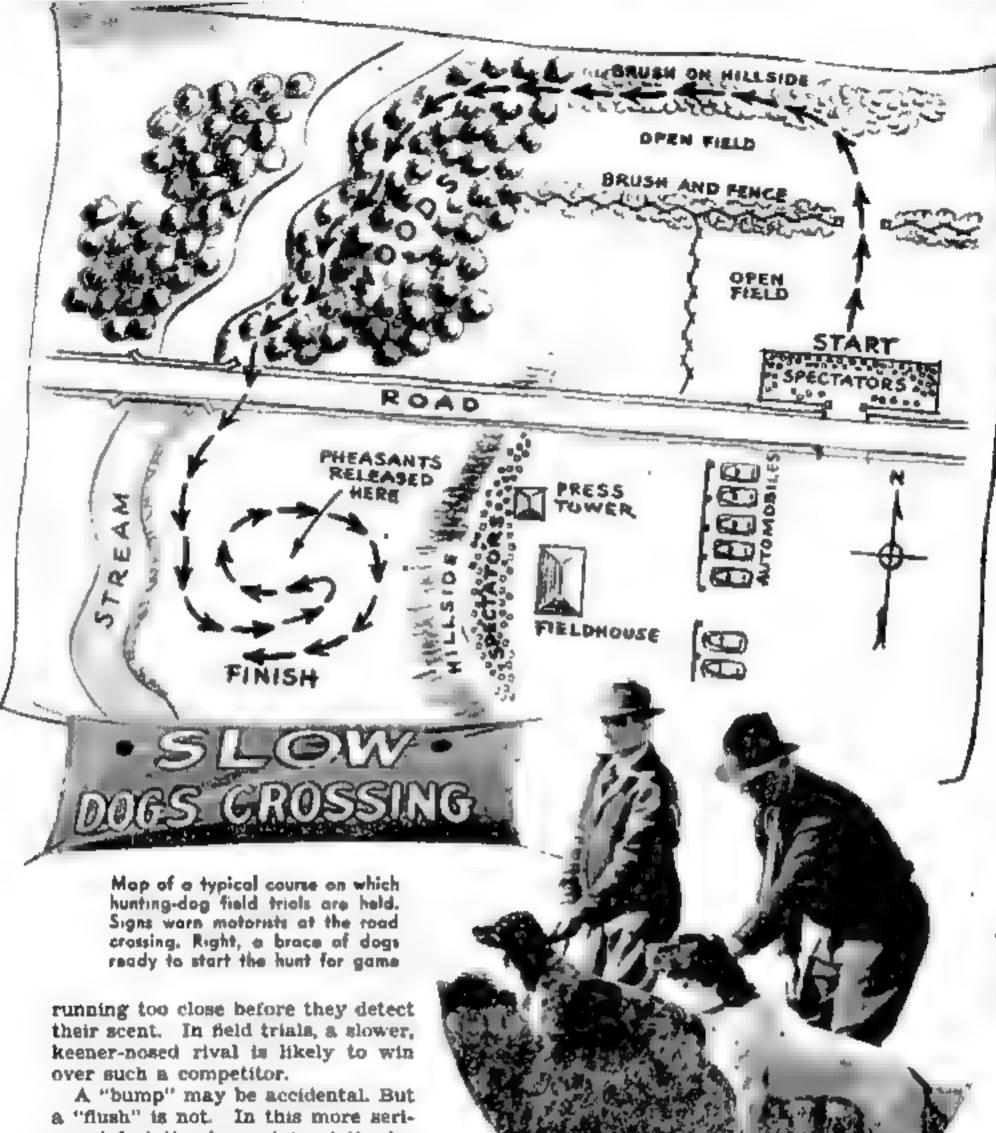
A few years ago, a brilliant young pointer in the South won fourteen victories in a single season. He seemed destined to become one of the greatest dogs in field-trial history. Then, at one contest, an insufficient number of kennels was provided. The young dog was kept overnight in a garage and during the evening, someone carelessly ran a motor. The fumes from the exhaust affected the delicate nose of the pointer, ruining its career.

Some dogs, trainers have found, are "too fast for their noses." They continually "bump" birds, scaring them into the air by



AMIMALS

as shown at the left



ous defect the dog points at the in-

visible quarry and then slowly walks in until the bird files up. Even worse is what is known as "blinking," The animal scents the bird but goes on without pointing, ignoring or "blinking at" the fact that the bird is there. Blinking is fatal in a contest. So is "interference," Here the dog cuts back and forth in front of its rival or rushes in and flushes a bird at which the other dog is pointing.

How long a bird dog will remain rigidly pointing at the spot where he scents game is a question hotly debated among sportsmen. At one recent meet, a trainer lost sight of his dog. He "hit" him again and again with

blasts of his whistle. Finally, after thirtyfive minutes of searching, he discovered the animal standing rigid among thick bushes, pointing at a clump containing game birds.

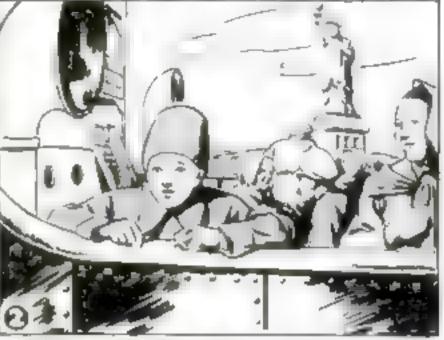
The distance at which such dogs can catch the scent of the quarry depends upon weather conditions as well as the direction of the wind. Some years ago, in England, a noted dog trainer named H. M. Budgett made exhaustive tests of (Continued on page 217)



Here's My Story



DAVID SARNOFF SPENT THE FIRST NINE YEARS OF HIS LIFE IN WEST CENTRAL RUSSIA, WHERE HE WAS BORN ON FEBRUARY 27, 1891



WHEN HE WAS NINE YEARS OF AGE, HE CAME WITH HIS FAMILY TO THE UNITED STATES. YOUNG DAVID WAS THE ELDEST OF FIVE CHILDREN



THE DEATH OF HIS FATHER A FEW YEARS LATER MADE HIM THE FAMILY BREADWINNER, SO HE STARTED SELLING NEWSPAPERS IN DOWNTOWN NEW YORK CITY



TO SUPPLEMENT THE SMALL AMOUNT HE MADE SELLING PAPERS, HE GOT A JOB AS MESSENGER BOY FOR THE COMMERCIAL CABLE COMPANY



FINALLY, HE LANDED A FULL-TIME JOB, AT \$5.50 A WEEK, AS A MARCONI COMPANY OFFICE BOY. AT NIGHT, HE PRACTICED CODE ON AN OLD SECONDHAND TELEGRAPH SET



IN 1908 HE GOT HIS FIRST ASSIGNMENT AS A WIRELESS OPERATOR, IN THE LONELY MARCONI STATION ON NANTUCKET ISLAND, OFF THE COAST OF MASSACHUSETTS. HE SPENT HIS SPARE TIME IN THE STATION LIBRARY, READING TECHNICAL BOOKS

THE INSPIRING CAREER OF DAVID SARNOFF



HE WANTED TO STUDY ELECTRICAL ENGINEERING AT PRATT INSTITUTE IN NEW YORK, SO HE ASKED FOR A TRANSFER TO THE SEAGATE, N.Y., STATION. THIS MEANT A \$10 CUT IN SALARY, BUT SHORTLY HE WAS PROMOTED TO STATION MANAGER



WHEN HE WAS TWENTY YEARS OLD, HE SERVED AS WIRELESS OPERATOR ABOARD THE J.S. BEOTH/C ON A SEALING EXPEDITION IN THE ARCTIC



IN 1912, AS A NEW YORK MARCONI STATION OPERATOR, HE PICKED UP WORD THAT THE S.S. T/TAN/C WAS SINKING. HE STAYED AT HIS KEY FOR 72 HOURS AND GAVE THE WORLD THE FIRST AUTHENTIC NEWS OF THE DISASTER



While commercial manager of the Marconi Company in 1915, he recommended developing a "radio music box" this turned out to be the forerunner of our modern home radio receivers



IN 1919, THE RADIO CORPORATION OF AMERICA ABSORBED THE MARCONI COMPANY, AND SARNOFF WAS MADE COMMERCIAL MANAGER OF THE NEW, ENLARGED CONCERN



AT 39, DAVID SARNOFF BECAME PRESIDENT OF RCA. TODAY HE ALSO HEADS THE NATIONAL BROADCASTING CO., IS A DIRECTOR OF THE METROPOLITAN OPERA AND OTHER IMPORTANT ORGANIZATIONS, AND HOLDS MANY HONORARY UNIVERSITY DEGREES



Hot-Air Cabinet Dries Fire Hose

AN AIR-CONDITIONED cabinet of new design makes short work of drying fire hose. Drawn into the machine, air passes over electric heaters and then circulates through the loosely coiled hose resting on shelves. The indirect heating is said to avoid possible damage to the hose, and the unit saves the time and work of hanging it up in a drying tower.

Fountain Pens Kept Clean by Chemical Bath

CHEMICAL "batha" for fountain pens are claimed to clean the parts and keep the rubber sacs in good condition. When a measureful of the flaky, white cleaning compound has been dissolved in warm water, the pen is immersed in the solution, which is circulated through the interior by working the self-filling lever. A can of the cleaner holds enough for fifteen "baths."



Flushing a fountain pen in the solution of chemical in water

Oil Heater and Stove Combined

ESPECIALLY suited for cabins of small boats, where space is at a premium, a oneburner kerosene stove and a radiant heater have been combined in a single compact assembly. For use as a heater, the burner is fitted with a perforated from ball, which becomes intensely hot. A concave reflecting surface concentrates the heat rays in the desired direction. In the accompanying photo, the convertible unit is shown as a stove and as a heater.



Attachments convert the oil stove at the left into a radiant heater

Flame Thrower Helps Fight Forest Fire



Mule loaded with portable outlit for starting back fires. It sprays floming oil on grass or leaves, as illustrated above

PEACETIME flame thrower to combat destructive mountain and canyon blazes. by setting back fires, has been perfected by U. S. Forest Service engineers at Santa Barbara, Calif. Using Diesel oil as fuel, the apparatus may be carried into threatened areas by truck, on muleback, or on a frame supported by two men. A small gasoline engine pumps the fuel through a forty-foot line to the nozzle. In a recent five-hour test, the machine sprayed forty-five gallons of oil, enough to start a back fire several miles long.

Addressing Machine for Home or Club

AN INEXPENSIVE new addressing machine serves homes, churches, clubs, and small businesses whose correspondence frequently goes to the same mailing list. Stencil cards, prepared on a typewriter, give as many as 10,000 impressions apiece. For use, up to sixty-five stencils are placed at once in a hopper at the left of the machine. The user then places each blank envelope in turn against a guide, uses a fingertip shift to flick a stencil into position beneath an inked roller, and depresses a printing handle. The method is said to produce neatly printed names and addresses at eight times the speed of hand addressing.



This device speeds addressing envelopes to mailing lists

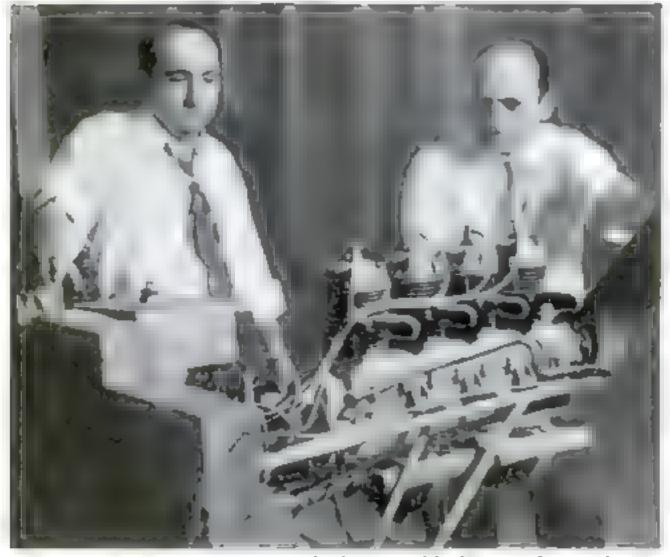
Beach Sunbonnet Is Collapsible





Serving as a beach umbrella in minleft is collapsible. Upper views show how it may be tucked away when not in use by bending the flexible wire rim into a figure 8, folding over the loops, and slipping the pancake-shaped result into a handbag for beach accessories. The linen top that serves as a sunshade is available in a large variety of colorful patterns. Despite its wire frame, the hat is light in weight,

Lightweight Plane Motor Has Few Parts



Victor and Charles A. Toce with their simplified motor for airplanes

DISPENSING with a carburetor, a radical new airplane motor has been designed by Charles A. and Victor Toce, of Houston, Tex. Using half as many parts as a standard motor, they claim, it will develop twice the horsepower with the same displacement and less weight. In addition, they call their engine inexpensive to build and well suited to mass production. The two brothers have offered it to the U.S. Government, which recently has created a special board of experts to pass judment upon the military usefulness of civilian inventions.

Transparent Clarinet and Mouthpieces



transparent plastic material like the one being examined by Paul Whiteman, famous orchestra leader, in the photograph above. While the entirely transparent clarinet is still something of a novelty, mouthpieces of the

new material are now available to clarinetists for use with conventional instruments of wood or metal. Light in weight, the transparent plastic mouthpieces are said to be durable and proof against warping and splitting.

Electric Stop Watch Is Easy To Read

USABLE wherever it can be plugged into a 110-volt A.C. electric outlet, a novel electric stop watch has a counter like the odometer on your car. This makes it easy to read time in intervals as small as one tenth of a second up to 10,000 seconds, or about two hours and forty-six minutes. Pressing a button sets the timer back to zero.



Time is recorded on direct-reading counter



Sponge-Rubber Building Set

FIGURES of birds, animals, trees, trains, and other objects can be constructed from novel blocks made of sponge rubber. Put up in kit form with a supply of rubber cement and a wooden spreader, the die-cut rubber blocks are designed as an instructive and entertaining toy for children of all ages.

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Paper Made from Clay



In one form, alsifilm can be used as a wropping material instead of cellulose film or waxed paper

PAPER from clay, a remarkable new product for household, industrial, and war use, has just been developed at the Massachusetta Institute of Technology. While various kinds of it may be applied in familiar ways—as in transparent wrapping sheets and milk containers—the "mineral paper" is far more than a substitute for wood-pulp or linen paper.

In printing, its ultrafine texture imparts new clarity and detail to half-tone illustrations. Waterproof and nonabsorbent, it gives a much higher gloss than common paper. Unaffected by age, it may be employed for permanent records.

Its fibers can be made into filter cloth

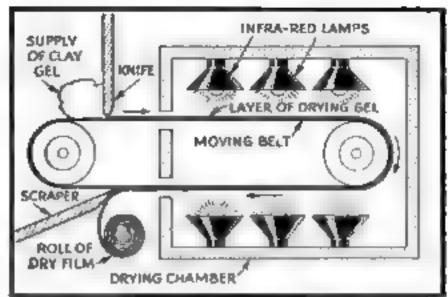
Other uses milk containers, threads, acidproof filter cloth, and molded parts for motors

invaluable to chemical industries, because of its resistance to corrosive acids and alkalies. A flexible sheet form can be wrapped around electric cables for insulation.

For mica, a strategic war material used in electrical parts of autos, planes, and radios, the United States depends almost entirely on imports from abroad. Since the new clay paper has the same chemical composition and electrical insulating qualities. stiff sheets of it should make an admirable substitute

Called alsifilm, the new paper takes its name from the first letters of aluminum and silica. These are the constituents of Wyoming bentonite, a type of clay that serves as raw material for light-brown "mineral paper." Another kind of bentonite, from California, yields white paper.

Ground to fine powder, the clay is suspended in water while grit and foreign matter settle out. Evaporated to a jellylike mass, the residue then is chemically treated according to the desired use. Ultramicroscopic mineral fibers mat together during the process, as fibers of ordinary paper do.



PAPER FROM COMMON CLAY

How a prepared clay is turned into paper. The view at right shows the mattad microscopic mineral fibers



Trucks Aid War on Mosquitoes

SING trucks of new design, motorized mosquito fighters now help rid Suffolk County, N. Y., of the insect pests. One type of vehicle allows an operator to unlimber B long-handled spray gun, for applying liquid to stagpant pools of water in street drains, without leaving his seat. When not in use, the gun is carried in B handy rack at the side of the machine. A larger



left, a driver treats a streat drain

truck carries a crew for more extensive spraying operations afield, in a determined campaign to make the marshy tracts of outlying Long Island uninhabitable as breeding grounds for mosquitoes, and so render it more habitable for humans during the summer season.

Workers removing rivets from dry-ice boxes for immediate use in planes

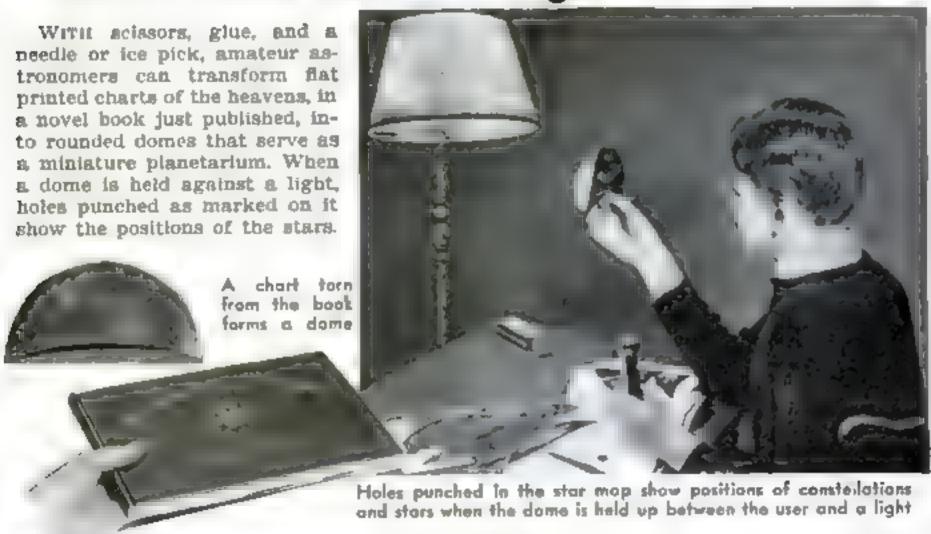
84

Refrigerators Keep Airplane Rivets Fresh

RIVETS for use in building giant four-engine bombing planes, seventyfour-passenger ships, and thirty-threehigh-altitude passenger planes transport stored in special refrigerator cabinets in a Scattle, Wash, airplane factory. Made of aluminum alloy, the rivets are first subjected to a heat treatment in a special unit built for the purpose, and then transferred to storage chambers maintained at a low temperature by solidified carbon dioxide, dry ice. The cold treatment is said to retard the aging or hardening of the rivets and thus keeps them indefinitely in the proper condition for driving. Rivets are taken from the chambers only as needed, and are driven into place within fifteen minutes.

POPULAR SCIENCE

Star Charts Make Midget Planetarium



Toy Balloons Help Opera Singer Get More Lung Power

DEVELOPING the lung power required to throw an aria into the back rows of the top gallery is a problem that Hilds Burke, New York opera singer, solves by the curious expedient of blowing up toy ballons. As part of her practice sessions, supplementing lessons in voice training, Muss Burke inflates half a dozen or more balloons every day. Balloon blowing, she believes, not only does a great deal to strengthen her lungs, but also tends to enrich her vocal tones. At the right, she is seen engaged in the novel exercise



Hilda Burke giving her lungs a work-out by blowing up ballaons



Memorandums put under the flap are always visible

Transparent Writing Flap Tops Off New Desk Cover

MADE in two sizes, for office or home use. a new deak cover is equipped with a top flap made of fireproof transparent material that provides a smooth writing surface. Being hinged, the flap may be raised to permit use of the blotter beneath. Calendars, memorandums, and other reference material can be placed underneath the flap.

Vibrating Brush Provides Efficient Scalp Massage

DESIGNED to massage and brush the scalp to stimulate natural hair growth, an electrically powered scalp brush now on the market vibrates at the rate of 5,000 times a minute. Made in models for both professional and home use, the brush is said to perform in three

twenty minutes if done by hand. The brushes are driven by means of a flexible shaft connecting the brush head with an electric motor. Opening two clamps on the side of the brush head allows the user to remove the brush for cleaning and sterilization. Monthly oiling is the only maintenance the outfit requires.





New massage device in use. Paper paddles slop the skin gently

Paddles Provide Cool Massage

Whirled by a flexible drive shaft connected to an electric motor, paper paddles in a new beauty device massage the skin. According to the inventor, the paddles create a circulation of air around the area being massaged, thus overcoming the objection of heat created by the massaging action. The device is intended for use by operators in beauty parlors and barber shops.

Standard Musical Pitch Broadcast

MUSICIANS who wish to check the tuning of their instruments can now do so by tuning in on WWV, the radio station of the National Bureau of Standards at Beltsville, Md. The standard for musical pitch, 440 cycles a second for A above middle C, is broadcast twenty-four hours a day, except when other Bureau programs are on the air.

Adjustable Sun Glasses Regulate Light

SUN GLASSES recently introduced can be adjusted by the wearer to admit more or less light, according to the brightness of the sun and its reflected glare. The sun spectacles utilize special lightpolarizing glass (P.S.M., April '36, p. 20). Each eye of the wearer looks out through two special lenses. The lens nearest the eye is stationary, while the front lens can be rotated by pushing a small button on the bridge of the spectacle frame. When the button is moved to the extreme left, the maximum amount of light reaches the eyes, but as it is pushed back toward the right, light penetrating the lenses is cut down until they are so dark that the brightest possible beach scene may be viewed without discomfort. Special louvered plastic side shields block out annoying reflections.





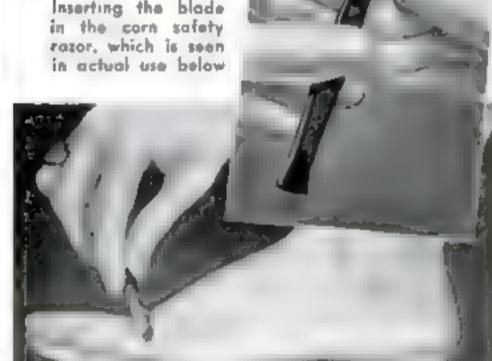
Gold Plating on Glass Makes Novel Jewelry

GLASS BEADS plated with gold or other metals are now available. The necklace pictured above is made of glass tubing, chopped into beads, strung, and plated by dipping into a special solution. It is said that the plated beads will not turnish or leave marks on the skin.

Safety Razor for the Feet Trims Corns and Calluses

CORNS and calluses may easily be trimmed with complete safety, it is claimed, by a new type of corn safety razor. Made with a molded plastic handle, the tool is equipped with a surgical-steel blade shaped to fit a metal guard in such a way that only the exact shaving space

necessary to pare corns is allowed between the blade and its guard, Blades are easily changed whenever needed.

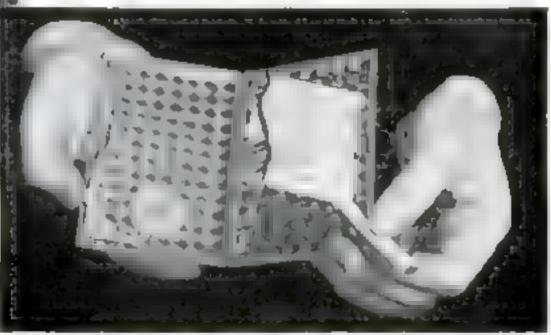


Cigarette Case Keeps Account of Smokes Given to Friends

A NOVEL cigarette case keeps tabs on the cigarettes your friends "borrow." When you want a smoke yourself, press one button to open the case But when an acquaintance "bums" a cigarette, press a second button. This not only opens the case but operates a counter built into the case,



When somebody codges a smoke, press a special button to open the case. A counter registers the gift, keeping track of those given away





Thousands of bats in the roost maintained by Milton F. Compbell, of San Antonio, Tox.,

LAYING host to 250,000 bats is the queer but profitable hobby of Milton F. Campbell, of San Antonio, Tex. His lakeside bat hotel, a tall wooden tower shaped like the base of a windmill, is the outgrowth of ex-

periments begun years ago by his father, Dr. Charles A. R. Campbell, at that time city bacteriologist of San Antonio. Believing that bats would rid the area of malariacarrying mosquitoes, Dr. Campbell spent years trying to induce the creatures to settle in a wooden roost which he constructed near the city sewage plant. Finally, by means of ear-splitting phonograph records, which drove the bata



HOTEL FOR BATS

At dusk, bots swarm out in clouds to feed on disease-bearing mosquitoes. At the right is a full-grown specimen. Dissections have shown that one but will consume thousands of the insects a night

single night's feeding. Since its introduction, the Campbell bat roost has been a source of revenue as well as a laboratory for the study of the strange little creatures it houses. Visiting bats, tens of thousands of them that choke the interior and often hang in great bunches from the outside caves, pay their rent by adding to the accumulation of guano in the roost.

Once a year, Campbell cleans this deposit from the interior, raking it down a chute at the bottom and sacking it up for sale. Bat guano is said to be a nearly perfect fertilizer. Sampled and labeled, as required by law, it sells for from five to ten cents a pound. Last year, the roost yielded nearly 6,000 pounds of guano. In fact, so profitable has the



unique venture become that quantities of the special lure used for attracting bats, and detailed plans for establishing similar roosts, have been sold to prospective bat raisers in several parts of the country, with an eye to both profit and mosquito control.



Karl Busch with same of the products of his novel postime

Artist Makes Faces of Avocado Seeds as Lapel Ornaments

PROBABLY the only avocado-seed carver in the world is Karl Busch, a Hollywod movie-studio artist whose hobby is turning the seeds into odd little faces to be used as lapel ornaments. Already, Busch has produced more than seventy-five of the oddities. Originally, the seeds are soft and easily worked. After the carving is completed, Busch places them in the sun for curing. When they are almost as hard as ivory, he paints them with bright-hued water colors and applies five coats of lacquer which give a high gloss and preserve the material almost indefinitely against rot.

Tiny Museum Holds 25,000 Rare Items

ORTY years ago, Frank S. Van Den Bergh, a retired estate superintendent of Santa Barbara, Calif, sent a shell he had picked up to a physician in Japan. In return, he received a shell from the Orient. That was the beginning of a remarkable one-room museum holding 25,000 specimens, most of them acquired by trading.

Excepting for short trips, Van Den Bergh has never traveled in quest of specimens. By correspondence, he has assembled, from eleven different countries, the 15,000 shells and the 10,000 miscellaneous items which cover the walls and

ceiling of his twelve-by-twenty-foot museum.



Frank S. Van Den Bergh shows a skull of a prehistoria Indian unearthed near his Santa Barbara, Calif., home

Besides 7,000 arrowheads, he has ancient skulls from the Southwest and a rare Indian boomerang used by an early American

hunter centuries before the coming of the white man. One unusual contribution from the Orient is a miniature reproduction of India's famous temple, Taj Mahal. It arrived smashed and had to be carefully repaired.

Among the vast collection of shells in his Tom Thumb museum, Van Den Bergh has specimens hardly larger than sand grains and others so big they once housed Australian clams that weighed 100 pounds. How much his complete collection is worth, he can only guess. One shell alone, a rare Voluta from Florida, would bring \$200. Recently, Van Den Bergh parted with seven shells for twenty-five dollars—the first cash sale he has made since starting his museum.

By trading with other collectors in two hemispheres, the hobbyist turned this small room into a private museum with 25,000 rare items



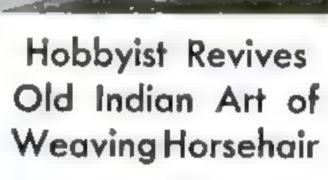
POPULAR SCIENCE

Toothpick Engineers Get Building Kit

FOR those interested in the hobby of constructing models with toothpicks and glue (PS.M., Feb. '40, p. 70), a New York manufacturer has just introduced a special kit. In addition to a supply of toothpicks and cement, the kit has a pair of cutting phers and a pair of small tweezers. The outfit, made in two sizes, is packed in an attractive box that is fitted with leather handles and metal locks to resemble a suitease.

This model playground slide was built with tools and materia's contained in the hit

As illustrated at the right, the outfit comes packed in a handy case with a carrying handle



Making belts, bridles, harness, whips, and other articles of borsehair is the unusual hobby that Eugene Barnett, of Grangeville, Idaho, has turned into a paying business. The art of weaving horsehair, once practiced by the Indians,

was revived by Barnett some thirty years ago, and he has been doing it ever since. Black horsehair, as well as hair dyed in various colors, is woven on a round dowel rod, as shown in the photographs at the left. Horsehairs of various colors make it possible to achieve interesting and decorative patterns in the finished work. A belt or bridle, woven on the rod, comes off in circular shape when finished, and is then pressed out flat. Barnett gets unusually high prices for his work.



Eugene Barnett engaged in his unusual hobby. The horsehair is woven on a round dowel rod, as shown in circle

Composer Collects Music Boxes

COLLECTING old and rare music boxes is the interesting hobby of Paul Taubman, New York planist and composer. His collection, rated among the finest privately owned in the world, includes such rare items

as the music box that combines a harmonium and a bird organ, an instrument that emits bird trills and was once used to teach canary birds to sing. Another is a masterpiece of ingenuity. Driven by a spring mo-

tor, it plays eight different tunes and can be set to repeat any selection or play the tunes in any desired sequence. The instrument also boasts a volume adjuster, bass and treble tone control, and a speed regulator, Taubman picked it up for twenty-five dollars, and values it now at nearly \$10,000. Interest in these musical machines, which often combine several instruments in one, led Taubman to master the art of playing a piano and an organ at the same time, as pictured at the left.





This ingenious Swiss machine plays eight different tunes in any order desired. The hobbyist is seen at the right with part of his collection. He haids in his hands a musical jewel box



HOBBIES

Fast Patrol Boat Mounts Heavy Armament



One of Uncle Sam's experimental masquito fleet, designed to guard important coastal waters in wartime

SMALLEST of the U.S. Navy's fighting craft, the fifty-nine-foot coastal motor boat PTS carries formidable armament into action at racing speed. With thirty similar boats ranging up to eighty-one-foot length, built or building, it will form an experimental mosquito fleet armed with torpedoes, depth charges, machine guns, and smoke-screen generators. The boats can be turned

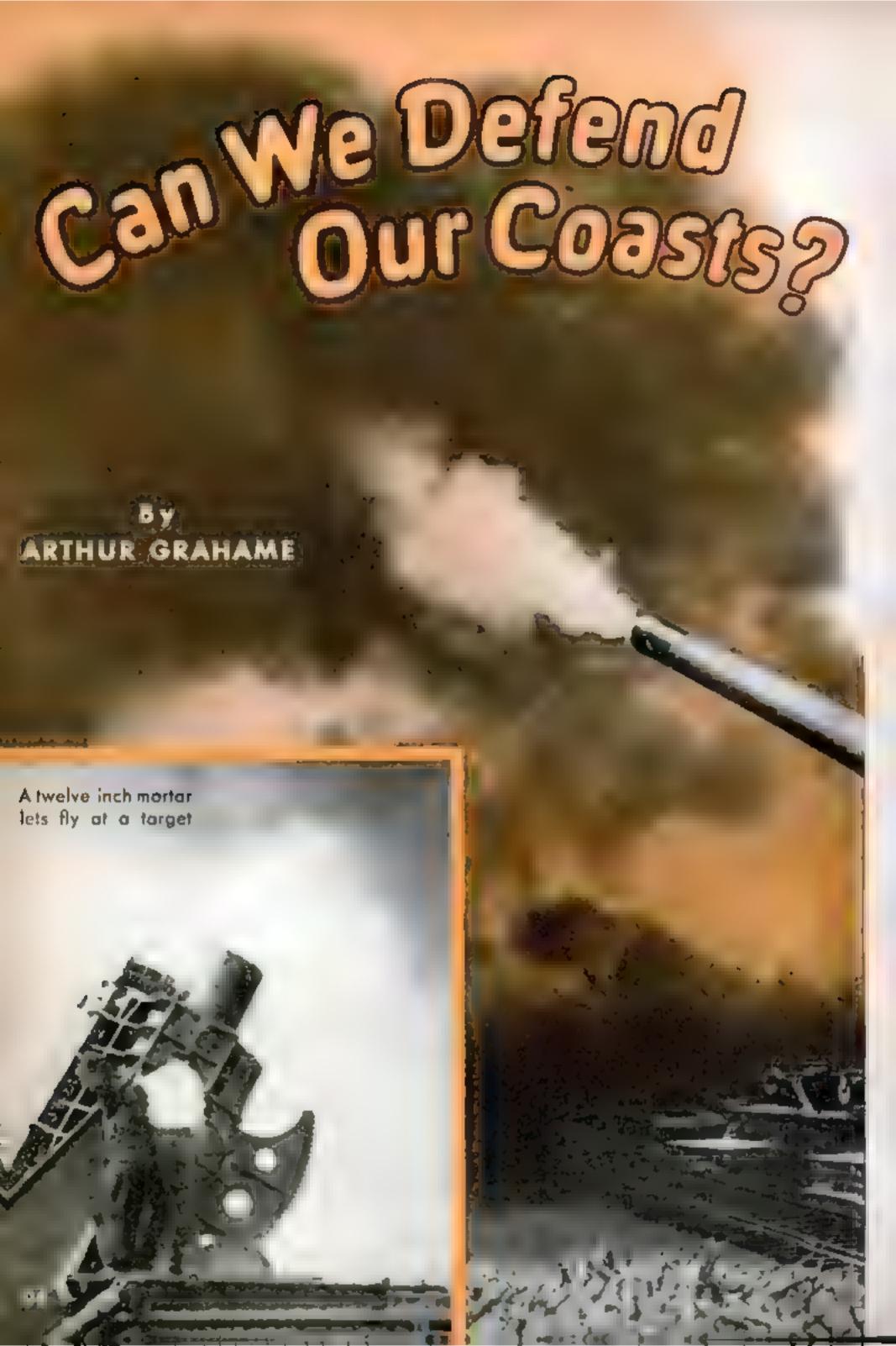
out rapidly by mass production. A potent threat to submarines and surface warships alike, they are intended mainly for patrolling such waters as Chesapeake Bay, Puget Sound, and the mouth of the Mississippi River. By taking over these duties, they would release destroyers for operations far at sea. The name, PTS, is the Navy's designation for "patrol torpedo boat No. 8."

Tank Engines Are Repaired in the Field

ENGINES of radial design, like those of airplanes, propel military tanks of the U.S. Army, Quickly demountable for repairs, the motors are easy to overhaul in the field, as shown at the right. The scene took place at recent maneuvers of the U.S. Army Tank Corps in Louisiana. Shortly after the picture was made, the speedy mechanized unit was rolling on its way.



Tank Corps mechanics overhauling a radial motor in recent Army maneuvers



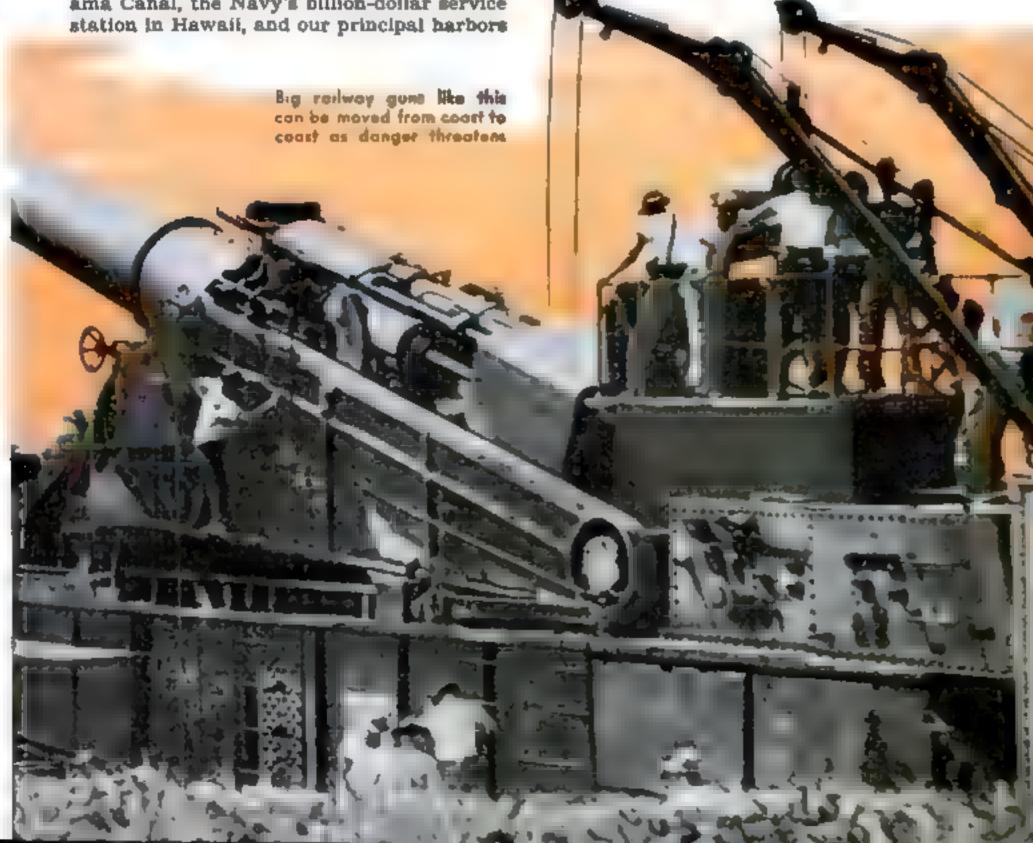
A GLIMPSE OF A LITTLE-KNOWN BUT VITAL LINK IN NATIONAL DEFENSE—THE COAST ARTILLERY

OST people think of the Navy as our first line of defense. In one way it is, and in another way it isn't. Its major war job would take it on an offensive mission—to head off and defeat an approaching enemy fleet, far from our home shores. Stringing out the big-gunned ships for close-in defense of our long ocean frontier would make their offensive use impossible, would abandon the seas to the adversary, and would surrender our overseas possessions and our maritime routes for obtaining vital war supplies. Our widely scattered warships would be push-overs for a concentrated hostile fleet. Therefore our "ships of the line" must be kept together, regardless even of the off chance that fleets in the Atlantic and Pacific might attack us simultaneously.

So if the word defense is used in its narrower, close-to-home sense, the U. S. Navy isn't a defensive weapon at all. Our first line of defense becomes the Army's Coast Artillery Corps. Its seldom-written-about soldiers man the big guns that defend the Panama Canal, the Navy's billion-dollar service station in Hawaii, and our principal harbors and scaport cities located on the mainland.

There aren't, and there never will be, enough guns in America to cover all our many thousands of miles of seacoast, Fortunately, that sort of defense isn't necessary. To have any real chance of success, a modern invading army must control wellequipped ports of disembarkation. Soldiers sometimes can be landed on an open beach. but it is next door to impossible to land tanks, large-caliber field guns, and all the other heavy material which is essential to present-day mechanized warfare without adequate facilities. So the chief wartime responsibility of the Coast Artillery would be the protection of the United States against invasion by keeping our important seaports safe against capture.

Other of its numerous duties would be guarding our thickly populated coast cities against bombardment by enemy warships, protecting the Navy's bases, and defending the fortified strong points in our system of seacoast defense, which would allow our



mobile ground Army and Air Force to remain concentrated for quick action against an invader who took the long chance of landing on some unprotected beach. To both the Navy and the Army the harbor-defense artillery is as invaluable as a good goalie is to a bockey team, and for the same reasonby playing Kitty-bar-the-gate it gives the rest of the team freedom to attack

To do their work of protecting us against invasion or bombardment from the sea, our harbordefense troops have two potent weapons-big guns and submarine mines.

The king-pins of their armament are the mighty sixteen-inch guns—as large seacoast guns as there are in the world except for a few eighteen-inchers which the British have mounted in their Singapore defenses. They have an extreme range of twenty-eight miles—the range of a sixteen-inch gun mounted in a battleship turret is about twenty miles—and at somewhat shorter ranges their one-ton nickel-chrome armorpiercing projectiles will perforate even the thick and tough face-hardened armor which protects the sides and turrets of a battle-



ship, and burst in the ship's vitals with effects likely to be deadly. Operated by electrical machinery, they can be fired for indefinite periods at an astoundingly high rate of speed. It is these mighty weapons which are most depended on to keep any hostile fleet well out of range of the vitally important locks of the Panama Canal, the naval base at Pearl Harbor in Hawaii, and cities such as New York and San Francisco.

Disappearing guns, in which the recoil throws the gun back to loading position behind a parapet and counterweights bring it back into firing position, aren't being built

> these days because sufficient enteen miles.

deck armor of any ship which ventures within their eight-mile range. Batteries of teninch and six-inch guns, which have ranges of about eight miles, are for use against cruisers, destroyers, transports, and other noncapital ships. A hit in a vital spot by a sixinch gun will put a destroyer out of action. Three-inch rapid-fire guns, which have a range of six miles, are used to protect mine fields.

All our fixed seacoast guns are mounted in harbor defenses, but not all of them are protected by concrete parapets or bombproof emplacements. Against the growing menace of the bombing sirplane, concesiment is considered even more important than protection, and some of our newest big guns are mounted in the open and depend on clever camouflage for comparative safety. Antiaircraft guns, both fixed and mobile, are provided for the protection of the big guns and the men who fight them from attack from the air.

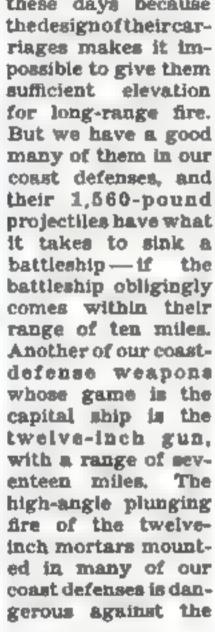
Railway artillery is equally valuable for supporting fixed guns in the defense of fortified positions and for use against an invader attempting a landing at a place not protected by permanent coast defense but within a reasonable distance of a railroad line. Fourteen-inch railway guns have a range of twenty-four miles; their job is to attack an invader's battleships and big cruisers. Eight-inch railway guns have a range of thirteen miles, and are for use against lighter warships and transports. Railway artillery has the important advantage of what the soldiers call "strategical mobility"-although it can't be moved very fast, it can be moved from one coast to the other.

Regiments of 155-millimeter tractordrawn guns-the same type of heavy gun that is used by our Field Artillery—also are part of our coast-defense system. They are capable of fairly high road speeds, and they

> do not require previously prepared positions. Their range is about ten miles.

> Both railway and tractor guns are highly important weapons in the defense systems of the Panama Canal and Hawaii.

Much less spectacular than the Coast Artillery's big guns, but every bit as important for the defense of our harbors, are its fields of submarine mines. Mine fields are carefully planned in peacetime, the mines and (Continued on page 218)





MILITARY

The men behind the guns: Coast Artiflerymen

looding a railway mortar at target practice

Coast Guard Patrols Sea Lanes

O KEEP an eye on all vessels approachthe Gulf of Mexico, similar patrols are also ing our northeastern coast, two-mile-abeing carried on. At present, more than minute flying boats from the U. S. thirty long-range Coast Guard flying boats Coast Guard station at Floyd Bennett Field, like that shown in the illustrations on this page, are engaged in the work. New York City, are combing the sea lanes in swift patrols. The flights carry them over an ocean beat that extends from Rhode Island to Maryland. Taking off in 1,700-horsepower Hall biplane flying boats that have a range of well over 1,000 miles, or in twinmotored Grumman ships that cruise at 125 miles an hour, the pilots and observers often head far out from shore. Whenever a vessel is sighted, the winged ship swoops down and circles until identification is complete. Should there be anything suspicious about the craft, a report is flashed by radio to shore headquarters. From other Coast Guard bases on the Eastern seaboard and on The pilot hands his radio aperafor a message for headquarters. reporting a suspicious vessel Wint -

Flying boot circling a ship for identification. Map is a report showing vessels sighted on potrol

Grooming the Iron Cavalry



By ARTHUR A. STUART

Confederate cavairy leader, is said to have remarked that the way to win in war is to "git thar fustest with the mostest." After three quarters of a century, no one has succeeded in evolving a more generally useful receipt for winning battles.

At Fort Knox, twenty-odd miles from Louisville, Ky., is stationed the Army's most modern implement for "gitting thar fustest with the mostest"—the fast-moving and hard-hitting mechanized force which is designated officially the Seventh Cavalry Brigade (Mechanized), but which the Army prefers to call "the fron cavalry."

In this supermodern cavalry the armored fighting vehicle has taken the place of
the horse, commands snap
out of radio receivers instead
of ringing from brazen trumpets, the staccato machine
gun has superseded the
gleaming saber, and the
monkey wrench has taken
the place of the pitchfork.
But in spite of all these
changes and innovations, the

iron cavalry still is cavalry. The troopers talk about engines and transmission systems instead of about horses and saddles, but they are trained to think fast and to act fast



MILITARY

and boldly, and so to carry on the great tradition of American cavalry.

The iron cavalry has the true cavalry coirit, and it is armed, equipped, and trained to do the traditional work of cavalry in war -to carry out distant scouting missions, to seize critical positions and hold them until the infantry has time to come up, to guard the army's flanks, to attack the enemy's flanks and go swinging around them to raid his communications and destroy his supply depots, to pursue a beaten enemy. When conditions of ground and weather are favorable for its use, the Mechanized Brigade is best suited to do many of these things, because it can go farther faster, and hit harder when it gets there, than can horse cavalry

The Mechanized Brigade consists of a brigade headquarters troop, two fully mech-

anized regiments of cavalry, a battalion of field artillery which has four motor-drawn firing batteries each of four 75-millimeter howitzers, an ordnance maintenance company for the fighting vehicles and a quarter-master maintenance company for the trucks and other vehicles, a signal detachment for radio communication, a medical troop, and a squadron of observation aviation. Its present authorized strength is about 2,000 men, but it is hoped to double its strength both in men and fighting vehicles.

THE backbone of the mechanized force's fighting power is its armada of 112 combat cars—two two-troop squadrons of them in each of the cavalry regiments.

Cavairy combat cars are light tanks with full track-laying mechanism. They have the same engineering features which make our





"Bringing up the guns." The gun crew rides in the same vehicle that tows the 75-millimeter howitzer

and drive, and long-wearing tracks of rubber composition set in steel blocks which have proved that they can stand up under even the intense heat generated by the friction of long, fast marches over sun-baked southern hill roads. A few of the combat cars have Diesel engines.

Weighing nine and a half tone, the combat cars-the troopers call them "hell buggies"—are a couple of tons lighter than the infantry light tanks, and they are faster and more maneuverable. Their top road speed is better than fifty-five miles an hour, and they can "cruise" at forty-five miles for long stretches without unendurable strain on either machines or crews. Cross-country. their top speed is considerably in excess of twenty miles an hour over average ground, and their obstacle climbing is spectacular. Because of their lighter weight, their armor isn't so thick as that of the infantry tanks. The iron cavalry is willing to sacrifice some degree of protection to get more speed.

Another feature in which the combat car differs from the infantry tank is that it has one turret instead of two, and that its guns may fire in any direction. The crew consists of four men, and the armament of one .50 caliber and three .30 caliber machine guns one of the latter in an antiaircraft mount. Each car also carries a Thompson submachine gun for close-quarters fighting, and each crew man is armed with a .45 caliber automatic pistol. This heavy armament gives the combat cars tremendous fire power. They also may be used as shock weapons. They won't be wasted in an attack on an enemy's carefully prepared main position. but when the right opportunity for their use arrives their thundering, lurching advance in fire-spitting waves will be the machine-age version of the boot-to-boot charge of yelling, saber-brandishing troopers.

In addition to its two squadrons of combat cars, each of the mechanized cavalry regiments has a reconnaissance troop and a machine-gun troop.

The job of the reconnaissance troop is scouting—especially long-distance scouting. One of the regiments is equipped with scout cars for this purpose, and the other with armored cars. The scout car is a fast, four-wheel drive vehicle with high sides of light armor. It carries a crew of from six to eight, and its armament consists of three machine guns mounted on a rail running entirely around the car's top, giving the gunners an all-around field of firs. The armored car is a six-wheel, rear-drive vehicle closed in over the top by a turret.

The business of the machine-gun troop is to cover the advance of the combat cars with their fire, and to give the iron cavalry increased defensive power when it is necessary for it to hold a position against an attack. The machine gunners do most of their fighting on the ground, but they ride to the scene of action—the troop of one regiment in scout cars, and the troop of the other in half-track personnel carriers. The latter are light trucks with the rear wheels replaced by a track-laying mechanism.

NOTHER distinctive type of combat vehicle used by the Mechanized Brigade is the mortar mount, a specially built fourwheel armored truck carrying a smoke mortar which its crew can dismount and set up to lay down a smoke screen to cover the advance or withdrawal of the brigade.

Motor cycles are used for various purposes, their riders being armed with rifles or with the submachine guns which the troopers call "Tommy guns."

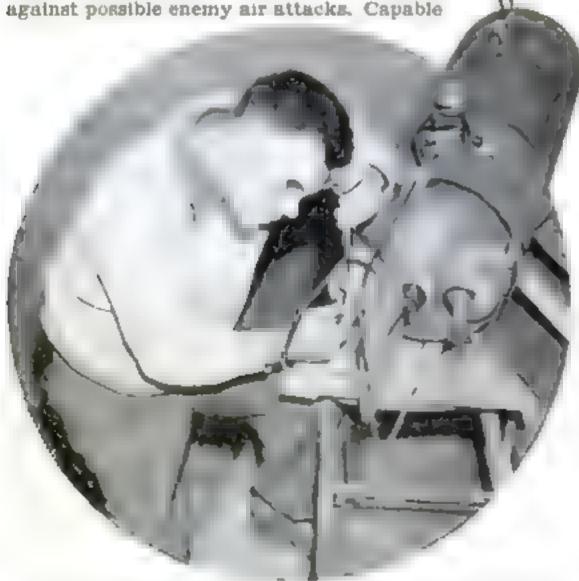
To keep up with an outfit which can move as fast and as far (Continued on page 222)



U.S. Army Gets a New Antiaircraft Gun

SAID to be effective against low-flying bombers as well as hedge-hopping attack planes, the antiaircraft gun pictured in action in the photograph above is one of the U.S. Army's newest weapons for defense against possible enemy air attacks. Cauable

of being towed from one position to another at high speed, the thirty-seven-millimeter gun fires at the rate of 125 shells a minute. Each projectile weighs one and a third pounds.



Rear view of the torpedo mine. Sound waves guide it to its prey

Electric Ears Aim Odd Torpedo Mine at Enemy Vessel

HUNTING its prey with electric ears, another version of the sonic torpedo (P.S.M., Mar. '40, p. 78) combines features of a mine and a torpedo. Four feet long and weighing 150 pounds, the torpedo-shape unit has twin propellers and a rudder. In use, the weapon is anchored under water. By means of an electrical mechanism, the noise created by the propellers of an approaching ship causes the mine to release its anchor and starts its propellers whirling. Guided by the sound waves set up by the ship, the torpedo-mine steers straight at its objective, exploding on contact.

Model Shows Tooth Formation



Tracing projected cross sections (top) and cutting them out of plastic

the exact manner in which enamel is formed on teeth Dr. Moses Diamond and Joseph P. Weinmann, of the Columbia University School of Dental and Oral Surgery, recently constructed a novel plastic model of an embryo tooth which is exactly 100 times the size of the original. The

Dr. Moses Diamond with the grant model of an embryo tooth, 100 times natural size. At upper left, the hinged top has been lifted

original tooth was first dissected by the investigatora into microscopie cross sections, which wers mounted on glass slides. These were then projected onto tracing paper, enlarged to 100 times their alze. These projected images were traced on the paper, which was then laid over sheets of a special plastic material. By gentle hand pressure, the tracings were transferred to the surface of the plastic, and the outline cut out with a knife. Cross sections of the original tooth varied in thickness from two to five microns, or thousandthsofamillimeter. so the plastic enlargements were therefore made from 200 to 500 microns

thick. When the entire number of cross sections had been completed, they were placed one over the other in the same respective positions as the original tooth sections, thereby producing the tooth model. Two and a half feet long, the tooth model has its upper half hinged to the lower so that interior details may be examined.

How Flant Ductors



Boring a hale in a tree to maculate it with virus, as at right

Protect Our Crops

Tree Diseases Studied Like Human Ailments

ORE than sixty scientists attached to the University of California's Citrus Experiment Station, at Riverside, are concentrating on a battle against the diseases that threaten countless acres of citrus groves, and deciduous fruit and date orchards of the southwestern United States Were it not for their activity in tracking down mysterious plant infestations, devising preventives and cures through ceaseless laboratory experimentation, and developing disease-resisting varieties, the nation s supply of oranges, lemons, dates, and other fruits might be seriously curtailed, and the loss to fruit growers would run into millions of dollars in a short time

Gas pumped into the ground with this "hypodermic" prevents spread of fungus to date trees

An arange tree growing in a 1,300 galon tank, if it passes tests, it will be employed in crossbreeding.

月月产学及MRSR-1840



Scientists Run Mouse-Trap Line



One of the mouse froppers examining a trop of the kind used, Beside him is a tray of specimens for study

Below is a section of the line. Stokes mark trop locations, Each trop is set in a runway and cavered by a box, as seen in circle

F A certain number of mice are living on an acre of land one year, there may be six times as many there next year, or there may only be half as many. Why? What causes animal populations to move in cycles? How long or how frequent are the cycles?

To solve these questions in the riddle of animal-population changes, B. P. Bole, Jr., and Philip N. Moulthrop, of the Cleveland Museum of Natural History have established a trap line they hope to maintain for fifty years. By trapping. every day except Sunday, over that period, the mice inhabiting a circular half acre of ground in Kirtland Hills, Ohio, the scientists hope to assemble mouse-population figures that will unlock the mystery. They may be able to predict the approach of "mouse years," and thus give advance warning against rodent damage. And the traps form a

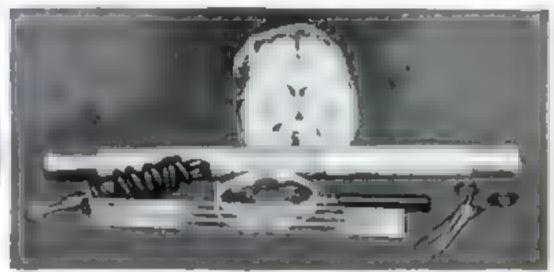
means of building up the museum's mouse collection, which now numbers more than 15,000 preserved mice, and is used to study, among other things, rodent diseases, some of which are suspected of being related to human ills. On the circular trapping area, 100 traps are set at all times, each being covered with a weatherproof box and placed in a hole that cuts into an underground mouse runway. Each day a member of the museum staff visits the scene, removes the catch, and resets the traps. Figured on the fifty-year basis, that means that more than 15,000 visits will be made to the trap line.

Rubber Film Preserves Specimens for Medical Demonstrations

Envelopes of a transparent rubberized material are being used by a Boston, Mass., neurologist for preserving sections of human brain and other medical specimens employed in lectures and demonstrations. After a month's treatment with a preservative, specimens are placed in the transparent sacs, which are then sealed by heat. In this form, the material is handled and transported easily.



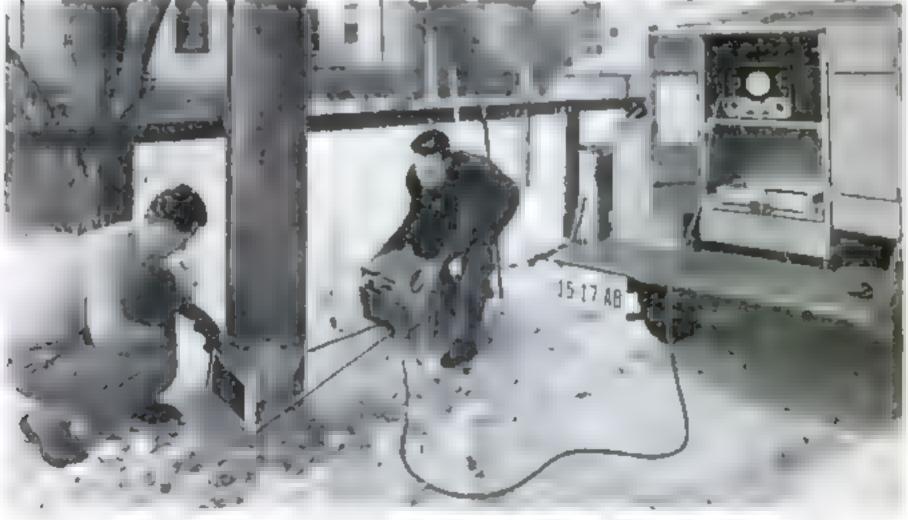
Sections of human brain wropped in transparent film. At the right is the equipment used in preparing them



X Rays Spot Decayed Power-Line Poles

Wooden poles that support electric-light wires are now being X-rayed to determine whether they are sound, or decayed to the point of requiring replacement. A Detroit, Mich., utility company utilizes a portable X-ray unit, inclosed in a cabinet mounted on a small truck, as shown in the photo-

graph. The poles are photographed at their bases, just below the level of the ground, where decay is most prevalent. Boring is the orthodox method of testing the poles for decay, but the X-ray system, in recent tests, is said to have proved more accurate and less wasteful.



Testing a pole for decay. X rays are aimed slanting downward through the wood just below ground level



anchored in place and pointed earthward. For Edward S. Forman and John W. Parsons, the California rocket researchers, are mainly interested for the present in studying the action of various fuels for stratosphere - stabbing rocket ships, and the effect of their intense heat on various types of nozzles.

This question of rocket-motor nozzles is one of the major problems now facing rocket experimenters, who are constantly devising new

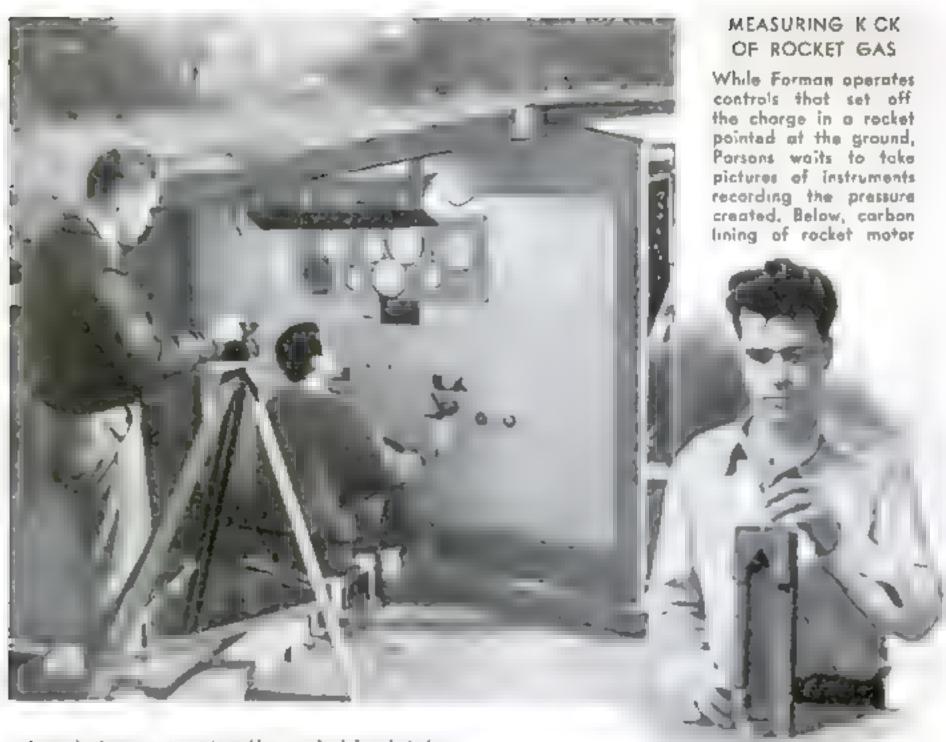
improvements and new methods to take the rocket out of the realm of fantasy and into the field of practical use. Booster motors to assist rocket take-offs, gyroscopes to guide flights along straight paths, watercooled nozzles, range finders to record altitudes and speeds, automatic parachutes that return the rockets safely to earth—these are some of the devices that are now being tested and brought to perfection by laboratory experiments on a dozen fronts.

North of Roswell, N. M., for instance, rockets wobble skyward from a sixty-foot tower, and then straighten out into a true vertical path, soaring up two miles into the air at a speed of more than 700 miles an hour. At the top of their flight, they hang in air a split second, then tumble over and float gently down to earth as their parachutes automatically belly out. The gyroscopic mechanism that straightens out the initial take-off wabble is a development engineered by Dr. Robert H. Goddard, rocket pioneer. Stabilizing vanes attached to the rocket are automatically controlled by the gases of the

By ROBERT E. MARTIN



tiny nozzle. The general view at the far left shows the sandbagged autdoor laboratory that is used by Parsons and his associate, Edward S. Forman



exhaust stream, moving the rocket back into line when it wanders ten degrees away from a vertical path.

But actually how close is rocket science to practical exploration of the stratosphere at an altitude of, say, fifty mites? Studies at the California Institute of Technology lead investigators to believe that with the exhaust velocity of 7,000 feet a second obtained by Goddard's rockets, powder rockets could now be built capable of rising 100,000 feet. In fact, under some conditions, they believe a gas-propelled, eighty-five pound rocket, exhausting its burned fuel through a nozzle at the rate of 12,000 feet a second, could rise under power to an altitude of fifty miles, and then continue, "coasting," straight up for another 175 miles.

For more than three decades scientists have sought ways to explore the atmosphere at great heights. Today their thoughts are turning to levels where rockets would fly through a vacuum, and celestial observations might be made without interference from city lights, haze, clouds, or air molecules of lower altitudes. One well-known astronomer even went so far as to suggest the possibility of a complete astronomical observatory, raised a thousand miles above the earth by one set of rocket motors, and maintained at that level by another.

Of more immediate practical application is the proposal that rockets take over the duties of heavy artillery in laying down a concentrated bombardment of an intensity not reached even with dive-bombing airplanes and the latest type of field and railway guns. Major James R. Randolph, of the U. S. Army Ordnance Reserve, recently declared that rockets could easily equal the performances of long-range guns firing shells as far as seventy miles.

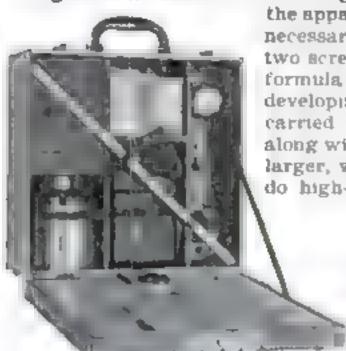
These long-range cannon fire a projectile eight inches in diameter. "Instead of firing shots of moderate caliber at long intervals," said Major Randolph, "a rocket plant could fire the equivalent of twenty-four-inch shells as fast as desired."

Projectiles envisaged by this officer would weigh four tons. Thousands of them, set off simultaneously or in volleys, might lay down in a few minutes a withering barrage that present artillery could equal only over a long period of time.

Armor-piercing rockets, Randolph further proposed, could be carried by submarines, while on land, the rocket shells could be transported in ordinary motor trucks bearing no resemblance to artillery weapons now easily identified by enemy planes.

Portable Enlarging Outfit Fits in Traveling Case

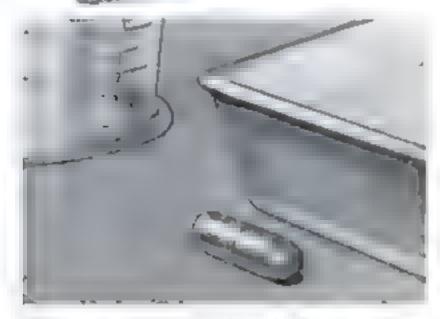
SO COMPACT it can be carried in a luggagetype case only four inches longer than this page, a new miniature enlarger permits travelers to turn any hotel room or tourist-camp cottage into a darkroom for enlarging. To set up



the apparatus, it is only necessary to tighten two acrews. Chemicals. formula cards, and a developing tank can be carried in the case along with the little enlarger, which is said to do high-grade work.

> Partable enlarger in its corrying case. If makes a dorkroom of any place you may be





This capsule is dropped in the film container

Sensitizing Powder Comes in Handy Capsule Form

STEPPING up the speed of either movie or still film from fifty to 100 percent, hypersensitizing chemicals in powder form are now offered for sale in capsules. To increase the speed of the film, all that is required is to drop one of the capsules in the film container and leave it there the required length of time. The chemicals in the capsule, which will keep for years, according to the manufacturer, act upon the emulsion and increase its sensitivity. There is nothing to spill or come in direct contact with the film.

Combined Film Projector and Viewer



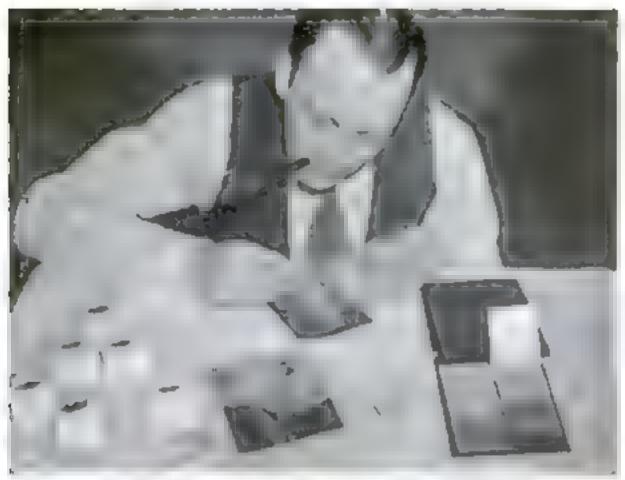
screen. If the user desires to see the picture enlarged, he simply turns a knob and the mirror swings out of the way, permitting a lens to project the

transparencyisalipped into place, a movable mirror throws the image on a viewing

magnified picture on a wall or screen for more detailed examination.

PHOTOGRAPHY

New Accessories for



The coloring fluid is made by dissolving strips of paper in water

Prints Colored with New Tints Are Ferrotyped

COLORED photographs now can be ferrotyped and given a high gloss through the use of chemical tints which are sold in blotterlike strips and applied with pipe cleanera for brushes. When pieces of the strips are dropped in water, they produce the coloring fluid used on the photographs. This fluid sets quickly so the print can be soaked in water after the coloring is completed, and then ferrotyped.

Exposure Meter Shows Density of Negatives

FOR DETERMINING the relative density of color-separation negatives, a new device makes use of a conventional photo-electric exposure meter. The meter is placed on top of the apparatus where it receives light projected upward through a negative. The denser the negative, the less the light reaching the meter. A special scale attaches to the regular meter.



Using an exposure mater to gauge density of negatives

Compact Circular Developing Tank Parts of the new circular developing tank, shown assembled at left

PHOTOGRAPHY

More compact than the conventional rectangular developing tanks for cut films and film packs, a new circular product with a spiral-groove reel permuts the amateur to de-

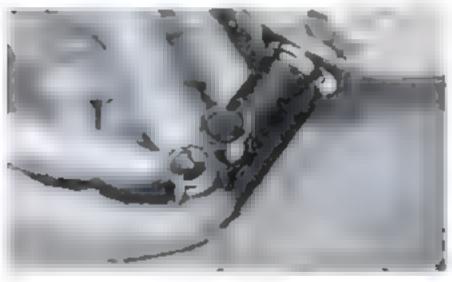
> velop his films with a minimum of chemicals, according to the manufacturer. By sliding the top section of the synthetic-resin reel up or down, films ranging all the way from 35 millimeters to 21/4 by 31/4 inches can be accommodated.

Camera Enthusiasts



Light-Tight Necks for Photoflood Bulbs

BLACK necks on mushroom-type photoflood buibs now prevent stray light from spilling out and shining in the lens of the camers. Such lamps are designed with an interior aluminum reflecting surface which makes the use of a conventional reflector unnecessary. The new opaque coating, extending from the base of the lamp to a point beyond the beginning of the reflecting surface, makes the neck light-tight.



Spotlight on Flash Gun Aids Focusing in Dark

Focusing in reduced daylight or at night is simplified by a small spotlight which plugs into the battery case of an American-made flash gun. Whenever there is insufficient outside lighting for using the range finder or the ground glass of the camera for focusing, the beam of the little spotlight will provide a spot of illumination for the purpose. The lamp can be plugged into the flash-gun outlet in a moment. The attachment also provides a test for the strength of the flash-gun battery.

Socket Adapters Center Midget Flash Bulbs

To CENTER midget photoflash bulbs in standard-size reflectors, nickel-plated socket adapters are now available. One end of the device screws into the regular socket of a flash gun. The other is slotted to provide a bayonet lock which facilitates rapid reloading. One size of the adapter, with a short stem, is for small reflectors; another size, with a longer stem, for large ones.



Two adapter sizes suit large or small reflectors

Studio Camera Is Remotely Controlled

With this electricolly operated camere, a photographer spaps the shutter from any point

Below, a rear view showing motor that turns the film, and shutter-speed dial

LECTRICITY operates a new state of research. A remote-control cable and switch enable the photographer to snap the shutter from any point in the studio. The electrically operated shutter permits 1 1,000th-of-a-second snapshot



New Extension Adapter Ejects Used Bulbs BURNED fingers are prevented by a new

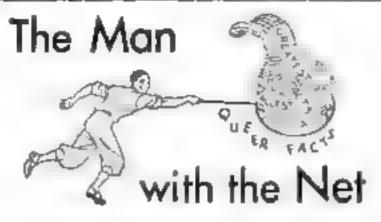
BURNED fingers are prevented by a new extension adapter for synchronizers, which contains a built-in ejector for "peanut-size" flash bulbs. Slight pressure on the ejector forces out the hot used bulb and makes handling unnecessary.

Enlarging Paper Packed in Perforated Envelope

To save trouble for the darkroom worker, one American manufacturer of enlarging paper is incorporating a perforated strip in the flap of the package. By gripping a tab at the end of the strip and pulling sidewise, the user can rip off the perforated section and quickly open the package, leaving a narrow flap to protect the contents.



Pressing the ejector forces out the hot used bulb



RAILROAD TIES in the United States are replaced at the annual rate of 100 ites a mile.

HYDROCHLORIC ACID is being used in England to give concrete highways a rough, nonskid surface,

FALLING through the doors of moving automobiles hills an average of 300 persons a year in the United States.

AMERICAN bombing-plane engines cost approximately ten dollars a borsepower.



AUTOMOBILE TRAFFIC in Times Square, New York City, averages six miles an bour, five miles an bour slower than the average speed of borse-and-buggy days.

RED BLOOD CELLS are manufactured in the human body at the rate of 30,000 a second.

MOUNTAIN-TOP LICHENS, it is estimated, live for 1,000 years.

PRUNE-PIT OIL has been found to be ex-



KENTUCKY LEGISLATORS once passed a law to the effect that Robert Fulton did not invent the steamboat.

EVERY SECOND of the year, an average of about 16,000,000 tons of rain and snow fall on the surface of the earth.

NOVA SCOTIA'S coast line is three times as long as the entire Pacific coast line of the United States.

KANGAROO TAILS provide fibers which are used for thread in certain types of surgery.



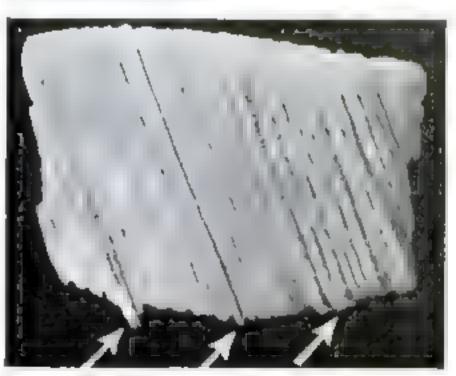


Spade with Two Handles Symbolizes Friendship

TWIN handles on a Y-shaped spade recently enabled American and Canadian officials to symbolize friendship while breaking ground for a new Niagara Falls bridge.

Ancient Sun-Spot Cycles Wrote Record on Clay

PREHISTORIC sun spots left their record on the clay bottom of a western river, scientists recently discovered. Just as the growth rings of trees show that every eleven years a season of extra rain results from sun-spot activity, so the clay deposits are thicker at similar intervals.



Arrows show thicker layers caused by unusual rains

POPULAR SCIENCE Question Bee

We've added a little variety to our quiz for your entertainment. Try to pick the right answer to complete the first five sentences. Then follow instructions for the rest. Answers are on page 223



- 1 You would be safest from lightning (a) in swimming (b) standing beneath a tail, isolated tree (c) under your bed (d) within a steel-framed office building.
- 2 A diamond-back terrapin is (a) a highly venomous snake (b) a piece of expensive jewelry (a) a turtle prized as a table delicacy (d) an issue of paper money guaranteed by Treasury deposits of diamonds.
- 3 If one of your car's cylinders fails to fire, the trouble may be a faulty (a) spark plug (b) flywheel (c) transmission (d) odometer.
- 4 To save weight in building ships and other steel structures, riveting sometimes is replaced by (a) pickling (b) welding (c) vulcanizing (d) electroplating.
- 5 A half hitch is a kind of (a) swimming stroke (b) auto-trailer coupling (c) knot (d) belt for a repair man who climbs telephone poles.

Answer "Yes" or "No"

If you aren't sure, try for a good guess

- 6 Are bats blind?
- 7 Do U. S. battleships fire torpedoes?
- 8 Should a hack saw be used to cut metal?
- 9 Is a spider an insect?
- 10 Can the pilot of a motorless glider ever soar higher than his point of take-off?

Censored Sentences

Each dosh stands for a letter in the same missing word in each sentence

- 12 A carpenter smooths wood with a ————; three points determine a —; a ————— is useful to an aviator.

Pairing Them Off

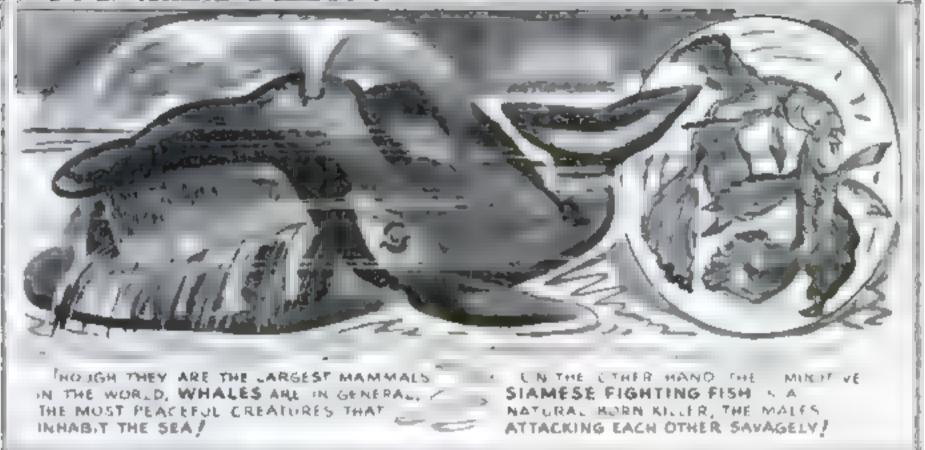
Can you supply the missing word commonly associated with the other? Doshes represent letters

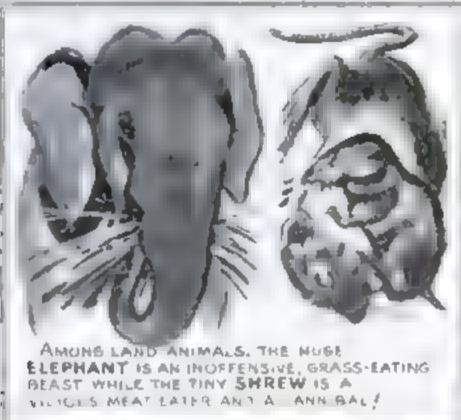
- 16 Flora and -----
- 17 Block and ----
- 18 Latitude and -----
- 19 Stress and -----
- 20 Brace and ----

Now YOU Ask US One!

We pay \$1 for each question accepted. Address the Question Bee Editor, Popular Science Monthly, 353 Fourth Avenue, New York City.

Un-Natural History Gus Mager





THAT B RO GIANT, THE CONDOR, IS A COWARDLY CARRION FEEDER, BUT THE PYEMY HUMMING BIRD IS A FEARLESS. PUGNACIOUS SCRAPPER!



WHEN FRIGHTENED, THE HOGNOSE SNAKE PUFFS HIMSELF UP TO LOOK LIKE A BIG. DANGEROUS REPTILE. IF THIS BLUFF DUESN'T WORK, HE ROLLS OVER AND PLAYS DEAD! WHAT A FAKE!





ALL FISH ARE DUMB, PRACTICALLY DEAF, AND HAVE UNLY THE CRUDEST SENSE OF SMELL! THOUGH THEY POSSESS A WELL-DEVELOPED NERVOUS SYSTEM, THEY ARE ALMOST INSENSIBLE TO PAIN!



Screening coal from the misture of mud and sand sucked from a river bed by the "vacuum cleaner" seen at right

Coal Mined from River Bed with Pumps on Odd Barge

PENNSYLVANIA miners are using an odd river barge to reclaim some of the fine particles of coal washed into the Susquehanna River from near-by coal fields. Through a pipe dragged along the river bottom, coal mixed with mud and sand is pumped to the surface, where it is extracted by screening.



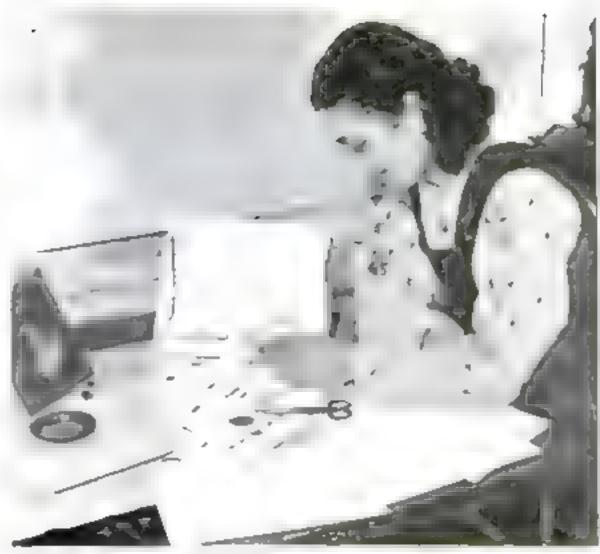
Turning the tables brings a new batch of work to the machine operator

Tables Turn To Speed Up Production

TO SAVE valuable time, four work tables are mounted corner to corner on a circular track in a California aircraft plant. When two operators have each routed a table load of sheet-metal parts with routing machines mounted on swivel arms, the tables are turned, bringing a new batch of work in front of each operator without loss of time.

Model Rooms Aid in Planning **Decorations**

To assist brides and other prospective home decorators in planning the furnishing of various rooms before they set off on a buying spree, a novel decorating kit has been introduced. With scissors and paste, floors and walls of individual rooms may be built to scale out of heavy paper. Then various cut-out forms representing furniture may be spotted about the model room to help the decorator decide what to buy and where to place it. Shopping lists and full directions are included in the kit.



Planning decorations with cut-outs and a model room from the kit



Chemically Treated Pads Keep Dogs' Coats Clean

COTTON pads saturated with a special lotion make it easy to clean dust and dirt from a dog's hair, to keep the animal's coat in first-class shape between baths. Eight inches square and packed eight to a jar, the pale-blue pada contain a disinfectant as well as a cleaning agent. The pads, which may also be used to swab and clean cats' fur, are said to be harmless to even the most sensitive skin. They are specially recommended for the care of city pets.

Button-Sewing Machine Does the Job Quickly

BUTTONS can be sewed in place within a few seconds, with a novel machine invented by Harry A. Landis, of Red Lion, Pa. As shown in the photograph below, the button is held with the first two fingers of the left hand, while the thumb and forefinger of the right hand pump a needle bar up and down. The vertical needle bar automatically moves horizontally so that the needle will enter the eyes of the button in order. A small clamp accessory furnished with the machine holds small buttons, snaps, and hooks and eyes that would be difficult to hold by hand.



Button sewer in use. Needle bar is worked by hand

Maio Companies



VEGETABLE CUTTER. Potatoes and other vegetables are out to various sizes and shapes by this accessory, as a lever forces them against Interchangeable cutting blades set in either end

WEATHER FORECASTER

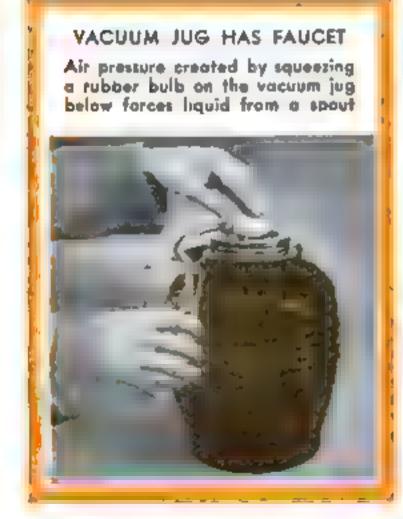
Changes in the weather are foretold by the ornamental barometer at the right. It consists of a pear-shaped plass globe with a graduated inner tube. The water level in the tube reflects changes in the atmospheric pressure

METAL CLOTHESLINE

Two twisted metal wires replace cord in the clothesline below. No clothespins are used, as garments are gripped between the wires, which are separated for the purpose by sliding a pulley along the line. Rustproof, the wires will not stretch









for the Household



WALL CLOTHES TREE

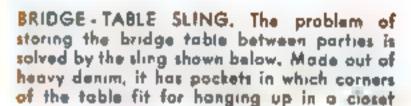
Fostened to a closet wall or door, this handy rack has all the advantages of a standing clothes tree. Its top ratates for more convenience TWO-WAY SHAKER, Divided into two sections, a new table accessory dispenses either salt or pepper. Pressing a lever, as shown below, shuts off the salt and releases pepper



TRANSPARENT CAP, Mode from a transparent rubber product, a novel cap protects the hair-do from water in the shower. It can also be used as a dust cap and for outdoor sports



A work chair, ironing board, bedside table, and stepladder are included in a versatile new combination unit. When it is used as a chair, as seen above, the ironing board becomes the back rest







This plant will have a good home while its owner is away

Model homes are built easily with construction kits

Plants Are Boarded at Hothouse Hotel

A BOARDING HOUSE for house plants is now in operation in the suburbs of New York City so that householders planning to be away from home on business or vacation trips can leave their plants in safe hands. The plant-nursery fees range from twenty-five cents a month for a geranium plant to ten dollars a month for a large, tubplanted orange tree. All rates are American plan.

Milk Is Kept Fresh by Novel Process

PRESERVING milk in hot weather without ice or refrigeration is said to be made possible by a new process. Gases are first removed from the fluid and replaced with oxygen. Then the milk is "smothered" with oxygen for several hours under pressure at from 104 to 176 degrees F. Saturated with oxygen in storage, it is said to keep for several weeks at room temperature.

Model Homes Built with Ready-Made Kits

now available. Various outhts for a large variety of house styles have parts ready to assemble, although they are left unpainted to allow the owner to select his own color scheme. Walls and roof are wood panels resembling siding and shingles, while doors and windows come in units ready to slip into openings.

Completed model house of early American design. Right, putting a window frame in place.

Horse-Meat "Worms" Fool Frogs



by making them think it alive is the solution worked out by H. L. Parker, of El
Monte, Calif., for the problem of diet in domestic bullfrog breeding. For twenty years,
Parker has been experimenting in raising
frogs as a food delicacy. Recently he decided to try feeding his frogs on a horsemeat menu, since he found it practically impossible to provide the frogs' natural live
diet of vast quantities of minnows, insects,
and earthworms. He contracted with the
owner of a near-by lion farm for a supply of

rections and snapped up the morsels with relish. Now Parker buys his own horses and has them butchered at a near-by processing plant to provide food for his amphibian livestock. Horse meat is fed to the frogs twice a week, and they thrive on it so well that Parker figures in seven months he can make about \$400 profit on an original \$100 investment, with a batch of 1,000 meat-eating

concrete frog tanks. Eddies of water created by a high-pressure water jet

from a pipe animated the meat strips and

made them appear to swim about on the

surface. Frogs came hopping from all di-

frogs raised for the market.

Glasses Let Color-Blind See Red Light

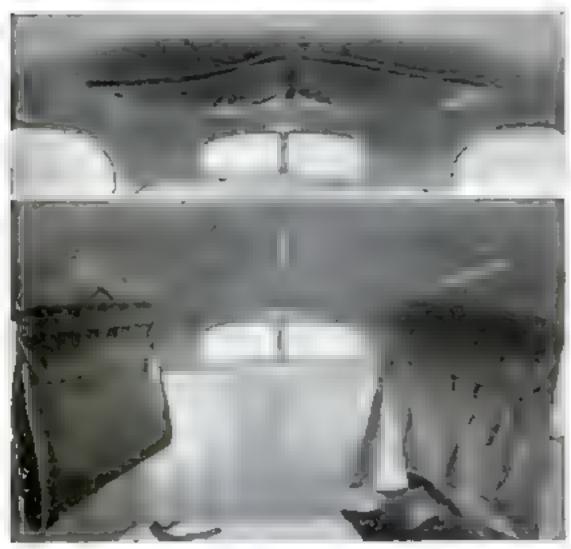




Through the special glasses, a color-blind driver sees light in the traffic standard only when the red or amber signal is shining

TO ENABLE color-blind motorists to determine whether a traffic light is red or green, a New York City optical firm has just introduced special glasses. The spectacles are made in two sections, the upper consisting of a segment of dark-red filter glass, and the lower of clear crown glass, although optically ground eye-correction lenses may be employed for those who ordinarily wear

glasses when driving. With the spectacles on, the color-blind driver looks through the red filter section of the lenses as he approaches a traffic light. If he sees any light at all in the traffic standard, he knows that it must be either red or amber, the "stop" or "caution" signal, since the filter blocks out all rays emanating from the green "go-ahead" light, while admitting the others. Since eye specialists estimate that one person in every twenty-five is colorblind, the filter glasses should make an important contribution to the problem of increasing traffic safety.



Garment bags open for inserting or removing suits. In the upper picture, they are strapped to the roof of the car for traveling

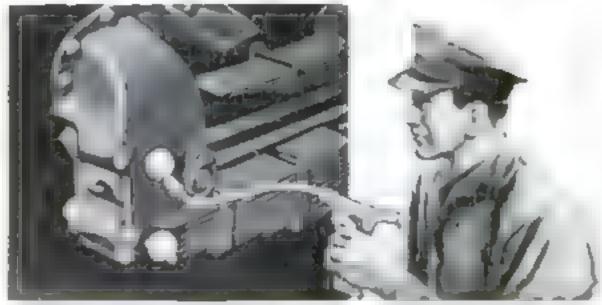
Car Travel Bags Strapped to Roof Out of the Way

GARMENT BAGS that fit out of the way flush against the ceiling of an automobile are a new convenience for tourists and travelers. A wire framework fits anugly to the ceiling of the car, extending across from the top of one side window to the other. Two detachable garment bags, made of imitation leather and fitted with hangers, are suspended by a handle from each side of the wire frame. When packed, the bags are swung up into an overlapping position on the ceiling and held in place by straps and hooks, as shown in the upper photograph at the left.

Lubricator Feeds Grease Automatically

AUTOMATIC lubrication of springs, control arms, drag links, and other automobile bearing surfaces is accomplished by an ingenious fitting. The simple unit is a small steel sphere, having a grease-gun fitting and designed for insertion into bearing holes directly, or indirectly through adapters. A hollow, synthetic-rubber ball fills the interior until grease or oil forced into the sphere collapses the ball, and compresses the air

within it. This compressed air tends to return the ball to its original round shape, a gradual process that pushes grease or oil into the bearing surface as the supply is used up. Each sphere holds a quarter of a fluid ounce.





Pumping greater into lubricator. A rubber ball, seen at left expands to feed it gradually to bearing surface



Blackjack Shifts Gears

Mane of soft rubber with a leadweighted ball at one end, the gearshift knob and shaft pictured at the left can be removed quickly for use as a weapon in case of a holdup or other emergency along the highway.



New Safety Light Makes Arm Signal Visible at Night

To ILLUMINATE the arm of an automobile driver at night, as he extends it to signal a turn or stop, a Los Angeles,

> Calif., firm has just introduced a special safety light. Designed to fit within a car at the back of the driver's window, the safety light can be installed in any make of car within a few minutes. The accessory has been endorsed by the Los Angeles Police Department, which has installed a number of the lights in its radio-equipped patrol cars.

Signating arm shows up plainly in light

of the special lamp shown at the right





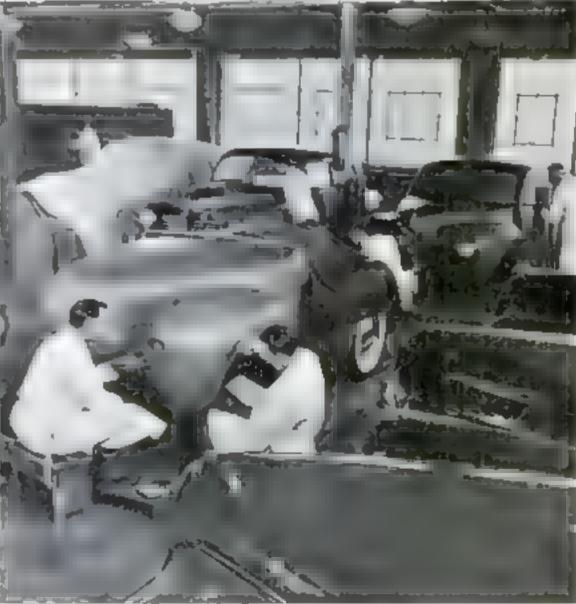
How the New Cars Are Designed

An artist sketches an exotic, streamline design on a giant blackboard. Sculptors model it full size in clay. Artisans carve it out of solid chunks of wood. Metalworkers fashion it in sheets of steel. Finally, a car of new and daring design is created, only to be driven virtually to destruction in brutal tests that will decide whether it shall be

scrapped, or become the newest product of a mass-production line. In the accompanying photographs, taken in the "art department" of the Chrysler Corporation, in Detroit, Mich., you see a few tentative models of the company's future cars. There, as in similar departments of other manufacturers, the endless process of improving the appearance and performance of cars goes on behind locked doors, to make your car of two or five years hence a reality.



Designing new dashboards. Right, making clay "mackups" of tentative models





New Battery Tester Speeds Car Service

QUICK checking of the condition of car batteries without removing them from the car is possible with a new accessory for service-station attendants. Cables attached to the unit are readily clipped to one battery terminal and the car's ground. As a motorist touches his starter button, visual indicators register the battery's condition.



Rubber on this hook prevents scratching the window

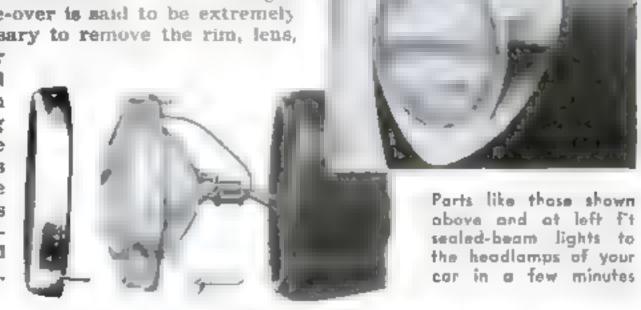
Rattleproof Coat Hooks for Auto Windows

Window Hooks for car doors that do not interfere with opening or closing the windows have just been put on the market. Coat hangers, coats, and other articles hung on them are held securely in place. Because the hooks are amply covered by rubber, there is no danger of their injuring the window glass under normal vibrations, according to the manufacturer. In addition, they are effectively prevented from rattling.

Sealed-Beam Conversion Kits

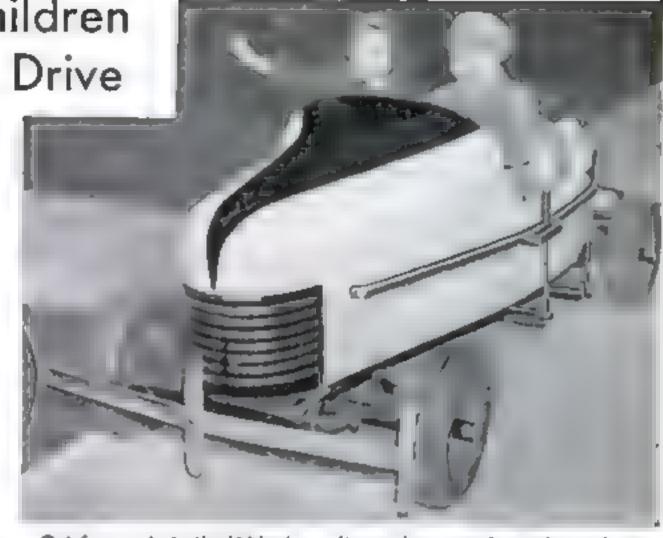
SEALED-BEAM lights can now be installed on cars a year or more old with the parts contained in a new headlight conversion kit. The change-over is said to be extremely simple. It merely is necessary to remove the rim, lens,

and reflector from your present headlamp, install the new parts contained in the kit, make several wiring connections, and replace the headlamp rim. Adjustments are provided for aiming the lamps properly. Two types of kits are available, adaptable to most standard makes of cars and trucks.



Car for Children Is Easy To Drive

DESIGNED and built by Karl Newhold, of Roseville, Mich., an automobile for children has an all-steel, racingtype body mounted on a sixty-four-inch wheelbase. The diminutive car is powered by a 21/4horsepower gasoline engine that drives the midget at a top speed of twenty-five miles an hour. Simplified controls consist of a steering wheel and a combination lever that operates not only the starter, but the brakes and clutch as well.



Out for a spin in the kiddles' car, It can do twenty-five miles an hour

Three Map-Reading Aids for Tourists



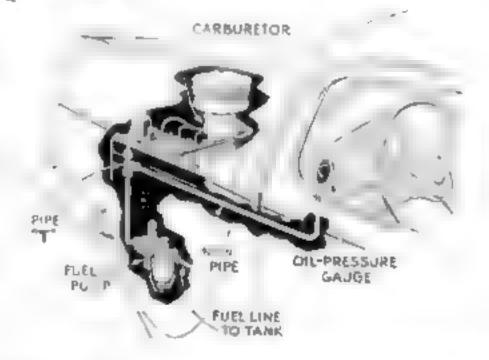


Reflector Button Inside Door Protects Motorist

FOR car repairs beside the road at night, it is a good safety measure to have a red reflector button fastened permanently on the inside of the left front door, or of either left door hinged at its front edge, as indicated in the accompanying sketch. If your doors are hinged at their rear edges, have a button on hand that can be hung on a door handle when needed. Motorists coming from behind when the door is open will see the reflector and be warned in time to give you and your car a wide berth.-R. H. P.



A GASOLINE-PRESSURE gauge to show that your fuel pump is working can be made from a length of copper tubing, a pipe T, and an old low-pressure oil gauge. The T is inserted in the line between the pump and the carburetor, and a new line run to the gauge mounted on the dash. For rubber-mounted engines, insert a flexible pipe to absorb vibration.—R. McC.





Wheel Lever Aids Moving of Cars in Garage

Two long bolts inserted in a four-foot length of two-by-four, as shown at the left, and hooked over at their ends, provide a highly useful wheel lever for moving cars about in a garage. In use, the hooks are inserted in the spokes or slots of a rear wheel, and the handle pushed in the direction it is desired to move the car. One man can thus move a car easily. Rubber tubing pushed over the bolts will prevent marring the wheel finish.—E. H.

Other cars

lights ilu-

minote the

reflector

AMATEUR MECHANICS



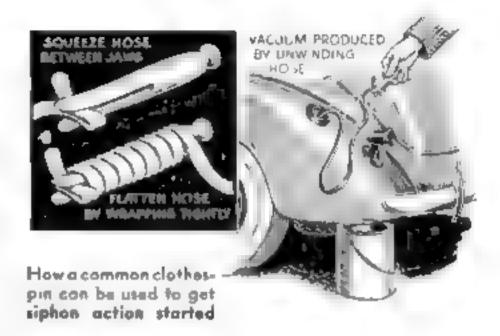
Long Magnet Recovers **Dropped Parts**

MANY mechanics have had the time-wasting experience of losing a key, washer, or nut in a transmission box or other out-of-the-way place in a car. A longreach magnet will get them out in a hurry. I made one from an old Model T magneto magnet, around which I

shaped a length of 5/16" from rod as shown, leaving parallel extensions about a foot long and an inch apart. The assembly should be seasoned for about twenty-four hours before attempting to use it, to become thoroughly magnetized.—R. S.

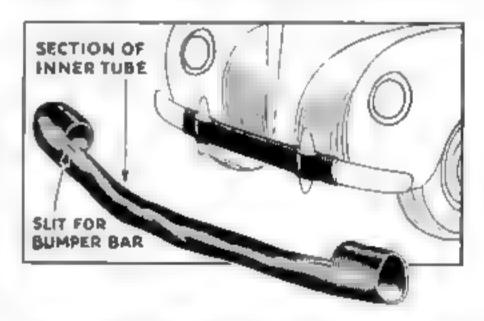
Rubber Bumper Protector Is Old Inner Tube

BY CUTTING a length of old inner tube in the manner shown in the illustration at the right, you can make an effective bumper protector for your car. Folded and stored under or beside the spare wheel in your luggage trunk, it will always be available for slipping on the bumper when you are called on to push a friend's car with your own. You will find that it will protect the finish of both your bumper and his from ugly scratches.-E. H.

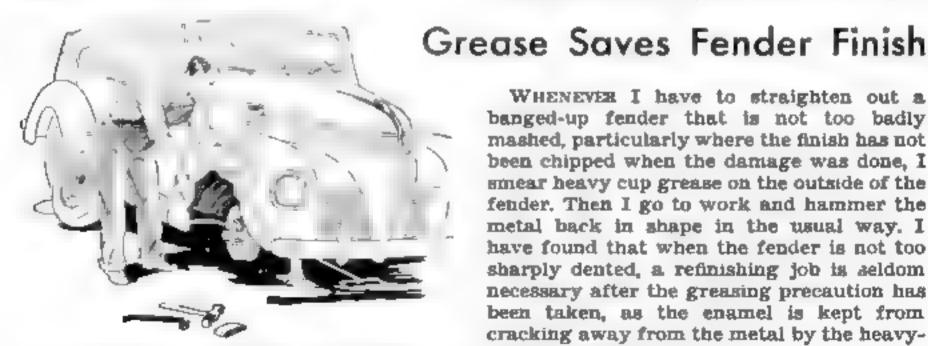


Clothespin Starts Siphon

You can use a clothespin to start siphoning gasoline from a car tank, avoiding the danger of sucking poisonous chemicals into your mouth. Pinch one end of a rubber tube between the jaws of the pin, and wrap the tube tightly over the whole pin. Place the other end in the liquid and unwind the tube. It will quickly fill with gas.-L, W.

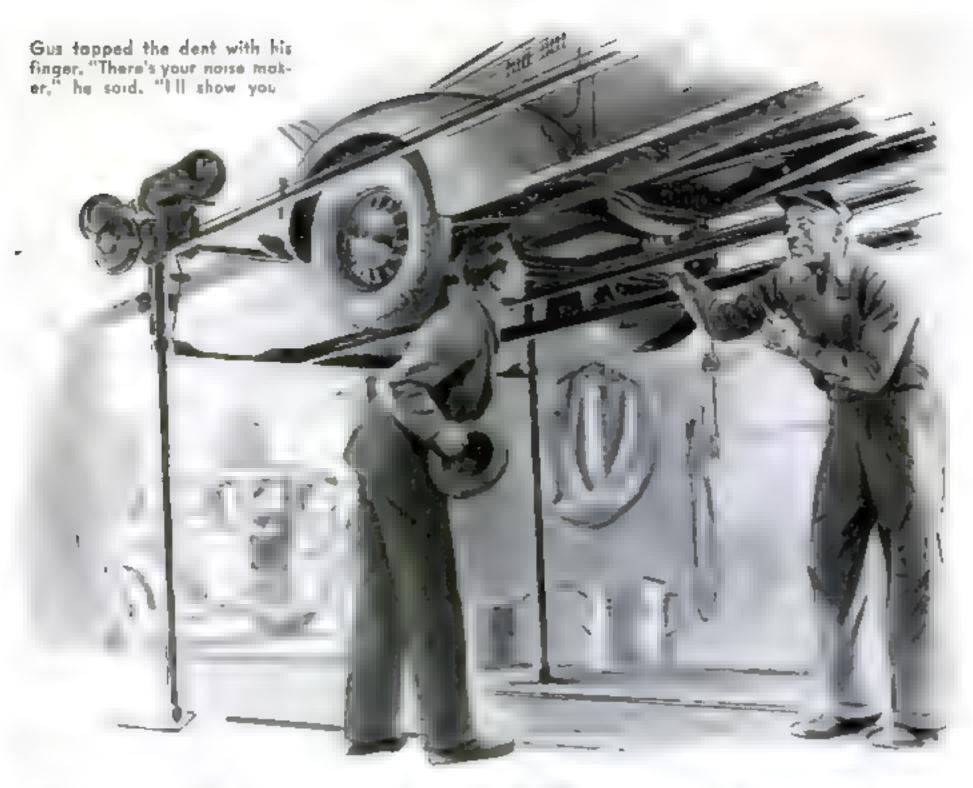


This pattern will make a guard for most car bumpers



Greasing the surface to keep point from chipping off

WHENEVER I have to straighten out a banged-up fender that is not too badly mashed, particularly where the finish has not been chipped when the damage was done, I smear heavy cup grease on the outside of the fender. Then I go to work and hammer the metal back in shape in the usual way. I have found that when the fender is not too sharply dented, a refinishing job is seldom necessary after the greasing precaution has been taken, as the enamel is kept from cracking away from the metal by the heavybodied material.-D. M.



Gus Listens, Then Looks

HE tan-colored roadster on the Model Garage's greasing rack was five years old and it wasn't of an expensive make, but Gus Wilson nodded satisfaction when he looked at it. Then he turned to the brisk-looking young man who had brought the job in.

"That's the way I like to see a car kept," he observed. "Shows that its owner has had sense enough to learn something about the machine he's driving, and that he isn't afraid of getting a little oil and grease on his hands. Without even stepping on the starter, I'm willing to bet you get good mileage out of the gas you burn, and that your engine does its job without making a lot of noise about it."

The young man laughed bitterly. "You'd win on the gas end of your bet," he said, "but you'd lose on the noise end. That engine does make a noise—a queer sort of noise that I've spent a lot of hours and quite a few dollars trying to kill. But I've

never been able to even locate it, let alone kill it. It's annoying, but it doesn't affect the car's performance."

"That so?" Gus said, immediately interested. "How come?"

"I bought the bus when it was three years old, and had about thirty thousand on its clock. I had new puston rings installed, spent several evenings getting everything else in first-class condition, and then started off on a two-week vacation trip. The first hundred miles or so were swell no trouble at all. Then I began to hear that noise—a light tapping. It sounded to me like a valve stem chattering in its guide, or maybe a broken ring. I got out and looked things over as thoroughly as I could on the road, but didn't find anything wrong. So I went on. So did the noise! But the car continued to run all right.

"That evening I checked things more thoroughly, but I couldn't find a thing wrong. Next morning it was the same as it had been the day before—not a sound for a couple of hours, and then that tapping again. It was like that every day for two weeks, and it darned near ruined my vacation.

"As soon as I got home I had the car gone over by the people who had installed the new rings. They said that the noise was caused by the push rods, which were worn and should be replaced. So I had them put in new

push rods. Same thing all over again—I'd start out all right, but after I'd been driving a couple of hours the tapping would start.

"Since then I've had the car in a dozen shops, but no one has been able to find the cause of that noise. Now I've given up looking for it. But at that it still bothers me."

"Sure—it would," Gus sympathized. "You never hear it until you've been driving a couple of hours, hey? That looks as if—"

He broke off, went over to the car, walked under the greasing rack, and ran a fore-finger over a small dent in the lower fly-wheel cover. "That's been there ever since before I bought the bus," the owner told him. "The first fellow who had ber must have dented it driving in a deep rut—or maybe a heavy rock hit the cover."

Gus nodded. "That noise you were telling me about," he said. "Is it any louder when you're doing fifty than it is when you're going about thirty?"

"Not much louder," the young man said.
"But the taps seem to be a lot faster when I'm going fast. At fifty the noise sounds continuous."

Gus tapped the dent with his finger. "There's your noise maker," he said, "I'll show you. . . . Hey, Harry, get that lower flywheel cover off, will you?"

His helper took the cover off. Gus examined its inside surface carefully. Then he pointed to a small burr, on which the metal was polished bright by friction. "There it is," he said. "A tooth on the flywheel starter ring that's maybe only a couple of thousandths of an inch higher than the others just barely touches that burr on every revolution of the wheel. I suspected something like that when you told me that the taps are closer together when you are going fast than they are when you are going slow. A noise like that

When It Comes to Curing Car Ills You Can Save Your Hands by Using Your Ears and Eyes

By MARTIN BUNN

it gets magnified, and by the time it gets out to you it might be coming from anywhere in the engine. Want me to fix it? Flattening out the burr and putting a little weld in the cover will do the trick."

"There's something I don't understand," the young man hesitated. "Why is it that I never hear the noise until I've driven a hundred miles or so?"

"Expansion," Gus told him, "That burr isn't high enough for t' it high tooth to hit it while the engine is fairly cool. But after a couple of hours of driving the engine gets good and hot. That causes the metal of the flywheel to expand—and that makes the high tooth hit the burr."

The roadster's owner still looked doubtful. "I know—you've been stuck before on this job," Gus said. "This time you needn't take a chance. If you ever hear that noise again, drive in here and I'll give you back your money."

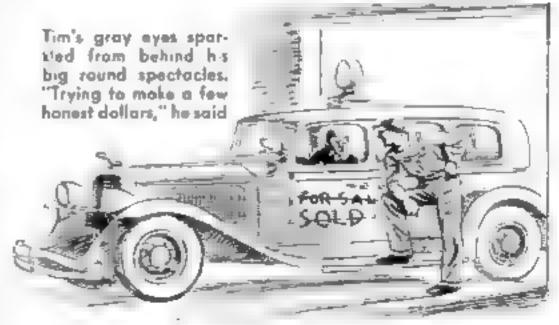
"Go ahead and fix it," the young man

An hour later, tousie-headed young Tim Sheridan, his dog, Dodger, on the seat beside him, drove into the shop in a sedan of '32 vintage and disreputable appearance.

"What the heck are you up to now?"
Gus greeted his favorite disciple.

Tim's gray eyes sparkled from behind his big round spectacles. "Trying to make a few honest dollars," he said. "I bought this old wreck for fifty, and I've dug up a guy who'll give me a hundred for it—i/ I can make it run right. That fifty-dollar profit is exactly how much more I need to get me through my first year at Tech."

"That close? Good for you!" There was appreciation in Gus's voice. He knows how



hard Tim has worked getting together the stake which will put him on the road to being able to sign "M.E." after his name. "Well, what's the matter with the bus—senile decay?"

"I don't know what's the matter with it," Tim admitted. "What was the matter with it was that it was so full of carbon that it knocked whenever it tried to climb a hill. I've scraped the carbon out, and ground the valves. But now it dies on me whenever I speed up the engine. It'll keep going, after

a fashion, with the choke all the way out, but when I put it in --dead!"

"Carburetor all right?" Gus asked.

"Yes. I cleaned it, and adjusted it. Gas line, too."

"How about the valve clearances?"

"Exactly what the book calls for."

"Then it may be the fuel pump," Gus suggested.

"That's what I thought, But it isn't

the fuel pump. I put in new diaphragms. Didn't do any good."

use them!

"Yes?" Gua said. "Let's have a look."

He examined the pump and carburetor. "Start your engine, and let it idle," he told Tim. The engine idled amouthly enough. "Huh!" Gus grunted. "Now speed her up." Almost at once, the accelerated engine stopped.

Gus felt the nut where the gas line connected with the pump to make sure it was tight. "What's this?" he demanded. He held up his hand, his thumb and forefinger were covered with some sticky substance.

"Shellac," Tim said. "I put some around the line nut to make sure it wouldn't leak."

"You did, hey?" Gus grumbled. Deftly, he dismantled the fuel pump. Then he carefully examined the check valve. "Take a look at this. See? The valve is gummed to its seat. Some of your shellac worked back into the valve seat. Clean it out thoroughly, and put in a new check valve."

Tim examined the valve intently. "You're right—as usual," he admitted. "The valve's stuck sort of half way—open enough to let sufficient gas flow through to keep the engine idling, but not enough to keep it running when you step on it."

It was quitting time, and Gus began to wash up. Tim perched on the workbench and rolled a cigarette. "You're a good guy, Gus," he said. "I sure do need that fifty dollars, and now I'll get it."

"Forget it," Gus growled. "Anyhow, I like trouble shooting. Keeps the old bean in working order. Did I ever tell you about the hardest trouble-shooting job I ever ran up against? It was four or five years ago. An ice-cream company down in the city bought a fieet of sedan delivery cars and outfitted them with dry-ice refrigerators. Before long, they began to find the cars' transmissions dry when they inspected them, and the grease in the differential housing instead of where it belonged. The manufac-

turer's service man told them to pack the rear-bearing lock-ring slots with ground cork—but that didn't do any good, and neither did anything else that they tried.

"The fellow who has charge of their garage is an old pal of mine, and when his boss began giving him real hell he called me up and asked me to go down and see if I could find the trouble.

"They were having

exactly the same grief with all their cars, so I worked on only one of them. I took its transmission down, and checked every part—O.K. I checked the alignment with the rear end—O.K. I did everything I could think of, and every night the car came in with its transmission almost dry and the grease in the differential housing.

"I began to lose sleep over the job—and I hate to lose sleep. One day I got down to their garage just as the car I had been working on was driven in. I got under it, and as I took out the plug to check the grease I heard a peculiar sort of hissing sound. That was the tip-off. Without saying anything to anyone, I took a small electric hand drill and drilled a very small hole in the torque tube.

"I was waiting when the car came in the next day, and I got under it in a hurry. The grease was all in the transmission, where it belonged, and I knew I had the trouble licked."

"All right," Tim said, "I'll bite. What was the trouble?"

Gus grinned. "The ring and pinlon gears created a suction which pulled the grease down the torque tube into the differential," he explained. "The hole I drilled killed the suction. In the next year's model the makers vented all their torque tubes. One of those little things—easy to fix, but the hardest trouble-shooting job I've ever been up against."

GUS SAYS:

Somebody tried to tell me that car

headlights are too bright nowa-

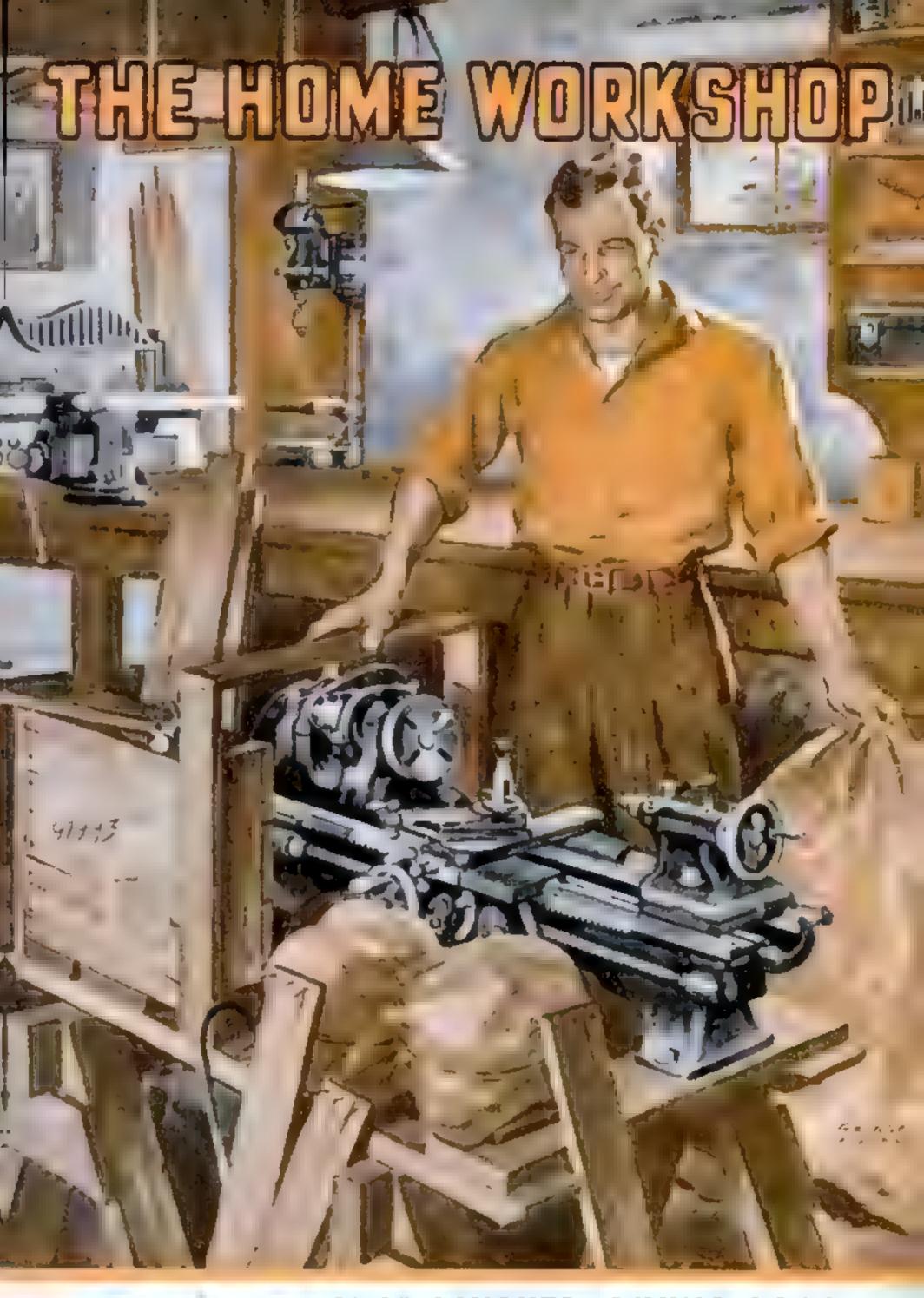
days. That's as foolish as saying

modern gas is too strong, cars too

fast, roads too good. Remember

this. They're all just as safe or

dangerous as the car drivers that



SHOP LAYOUTS DIVING GOGGLES

ACTION PHOTOS BOOMEBANGS PAINTING



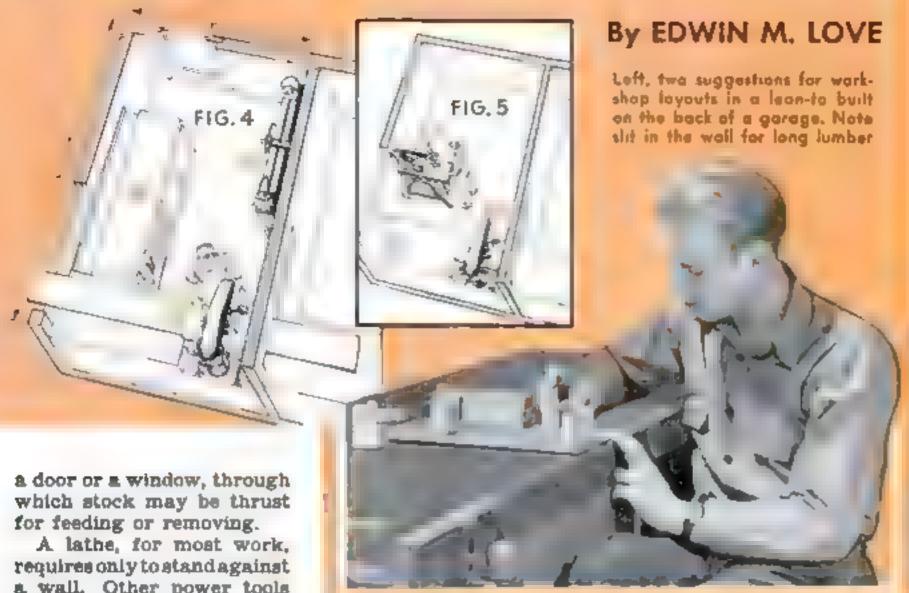
of a basement

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POPULAR BCIENCE

chines, or by locating the machine near

Your Home Workshop



The best way to plan your shop is to make rough models of the machines and move them about on a scaled layout of the floor space

A lathe, for most work, requires only to standagainst a wall. Other power tools usually need but two feet of space in front and at the sides. It is evident, therefore, that the placing of a

machine depends not only on accessibility, but also on the size and shape of the room, the other machines, and the type of work to be done.

The personality of the user also must be considered. The most convenient placing of equipment is often not the neatest, and if the owner is bothered by a lack of order and is oppressed by the feeling of restriction occasioned by irregular spotting of machines, he may find it best to arrange them according to appearance rather than their most efficient use.

This article suggests several arrangements for small shops equipped with from two to four individually driven woodworking machines. There is also a diagram of a fully-equipped shop, such as a home workshop club might own. It must be emphasized that these are only suggestions, intended to help in placing accessories to the best advantage in the room the owner has available. Later articles will deal not only with the groupings of several machines, but also the use of line shafts, gasoline-engine drives, and special model-making layouts.

These diagrams show no cabinets. Shouldn't they be considered in a shop plan?

It is the writer's conviction, as a result of much experience, that most accessories and hardware materials can be stored in cabinets under the machines and benches, and hand tools and lumber placed in racks on the wall or in hanging cupboards. Floor space is precious, so why build skeleton benches and mount machines on open stands, and then build floor cabinets to clutter up the room? Arrange the machines first, and adapt storage space to them. Cabinets and similar equipment will be fully considered in later articles.

Could a shop be started in a single garage?

If the garage is 12' by 20', as many are, it is possible to obtain a working space about 5' wide by driving the car close to one side. This is rather narrow and limits the number and kind of machines that can be chosen, but it is much better than nothing

Considering everything, the layout suggested in Fig. 1 is quite satisfactory. The

bench indicated is 6' long, with cupboard room inside and a good working space at the vise end. With the scroll saw adjusted for cutting from the side, not only can small lumber be handled, but long decorative bands or cut-outs as well.

The lathe is chosen because turning cannot be done by hand, or even imitated without prohibitive labor. If outboard turning is to be done, the machine is easily swiveled to a diagonal position.

How can end space in the garage be utilized?

Figure 2 is a good plan for a shop at the end of the garage. If a side door is present or can be cut in, set the circular saw near it, where long boards can be fed in. The saw, if equipped with rollers, can be pushed back at the end of the bench if the car encroaches. In this shop, moldings on straight work and outside curves are possible, but sawed curves and fretwork must be done by hand.

Must benches, and machines other than the circular saw, be placed against the walls?

No. Some of the best arrangements come from putting the ends to the wall, or even by standing equipment entirely out in the room, as in Fig. 3. This plan is excellent for irregular layouts, as in a basement. Notice that the drill press, lathe, and circular saw are within a radius of about 3' from the bench visc. A scroll saw could stand along the back of the bench within the same circle. All machines are within a couple of steps from the bench.

How may a small lean-to or other addition to a garage be made into a shop?

The plans in Figs. 1 and 2 would fit. Figure 4 is an ingenious arrangement for an addition built on the end of a garage 10' wide. Although the room is but 6' wide, long boards can be crosscut or ripped by the use of a circular saw of the overhead-track variety mounted on a bench at one end. A slit in the garage end and a large window opposite will allow stock up to 4' wide to pass. A supporting bench is built in the garage.

In Fig. 5, the bench and lathe are replaced with a scroll saw, the saw bench serving as a workbench and cabinet. Machine crosscutting and ripping, jointing, shaping, disk sanding, grinding, scroll sawing, edge filing, die filing, and metal sawing are pos-

sible in this shop.

Should the first machines be arranged in the order they would take in a complete shop?

Not necessarily. It is better to stand them where they will work to the best advantage. As more units are added, the work of certain machines may become more specialized and they will be less frequently

Saw and jointer combination is near a window, lathe is out of way but available for most work, scrall saw is by second window

> A three-in-line plan. Longer boards can be passed over scroll-saw table by raising blade guide. Other and of lumber extends over a lathe

used, so it may be better to shift them to a less desirable position. Nevertheless, the arrangement of the complete shop should be planned at the start so that windows, doors, and electrical outlets can be intelligently placed for that purpose. Minor deviations in the original plan can always be made if necessary.

LAYOUT FOR

FULLY EQUIPPED

POWER-TOOL

What about the arrangement of a commercial shop or one for a home workshop club?

Always arrange the machines to save as many steps as possible. In the mass production of an article, the machines needed should be close together. Step saving is clearly shown in the diagram on this page.

Another point to keep in mind is that if several men are working at once, the power tools should be so arranged that the operators do not get in one another's way.

(TO BE CONTINUED)

When planning a well-equipped shap, such as for a home workshop slub, arrange the layout in advance as a guide for placing electric outlats and other facilities. The ase at left is for a room 12' by 20'. Note how this layout saves steps, for example: A-1, operator cuts board off: A 2, rips and joints it: A-3 thapes molding. A-4, sands it for a turned place! B 1, he cuts stock to reath B 2 turns 1 for band-sawed we r: C-1, he cuts stock to length. C-2, lays out pattern: C-3, band-sawe it

In this arrangement band saw is by window, lathe can be used at front or end, and shaper can handle fairly long stack. A good grouping to follow when the space is restricted

At left, handy layout for a small shop having workbonch and two power tools. Note economy of steps. Window is not needed next to machines

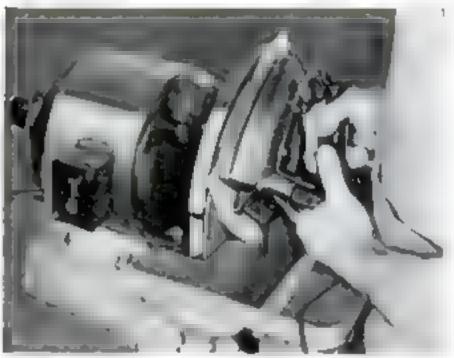


Two-Ply Baseboard Bends to Fit Curved Wall

BENDING baseboards to fit curved walls can be done readily if two or more thin layers are used, as illustrated above. Apply them to the wall separately. Fasten the inner layer or layers with screws, and the outer one with finishing nails. If the bend is sharp enough to require it, screws can also be used at the bottom of the outer layer where they will be concealed by the floor molding.—John Modroch.

Electric Iron Smooths Sanding Disks

STICK adhesive applied to sanding disks is likely to produce an uneven coat, especially if the metal is cold. After putting the sand-paper disk in place, cover it with a sheet of wrapping paper and press it with a fairly warm electric flatiron. The disk will adhere quickly, and all lumps of adhesive will be leveled off.—LESLIE KINNING.

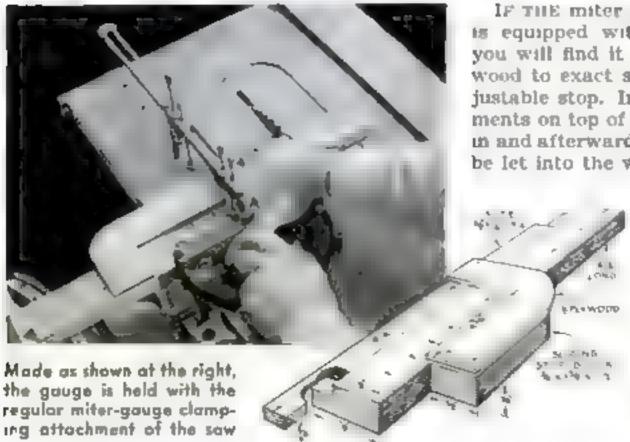


The disk of sondpaper is covered with wrapping paper and pressed with a fairly warm electric Iron

Using Blowtorch Near Woodwork

WHEN it is necessary to use a blowtorch on plumbing near beams, flooring, or other woodwork, a quantity of wet powdered asbestos may be placed on the area where the flame might reach to prevent a fire hazard.

Adjustable Cut-Off Gauge Added to Circular Saw



If the miter gauge of your circular saw is equipped with a clamping attachment, you will find it easy to cut small pieces of wood to exact size with the aid of this adjustable stop. In the original, the measurements on top of the body piece were scribed in and afterward inked, but a short rule may be let into the wood and will serve as well.

Dimensions of the original attachment are given at the left.

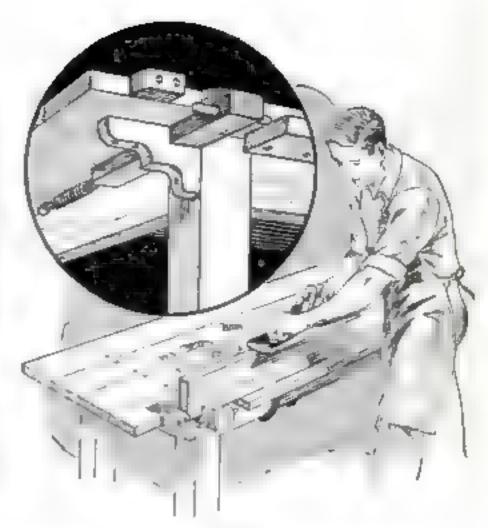
In use, the jig is slipped under two of the clamping screws, and the right edge of the body section is brought just up to the saw teeth and clamped. The sliding stop block is then set at any point desired and clamped.—G. H. S.

Planing Vise Adjusts Itself to Any Wood

For planing the edges of different thicknesses of wood, ranging from very thin up to 2", I have for years used the quick-acting vise shown at the right. It can be made small for model work or larger for general work. One great advantage is that it does not obstruct the surface of the workbench as is the case with the V-type planing stop so often used. A powerful spring is required. The one on my vise was taken from an old iron bed.—ABSOTT B. DAVIS.

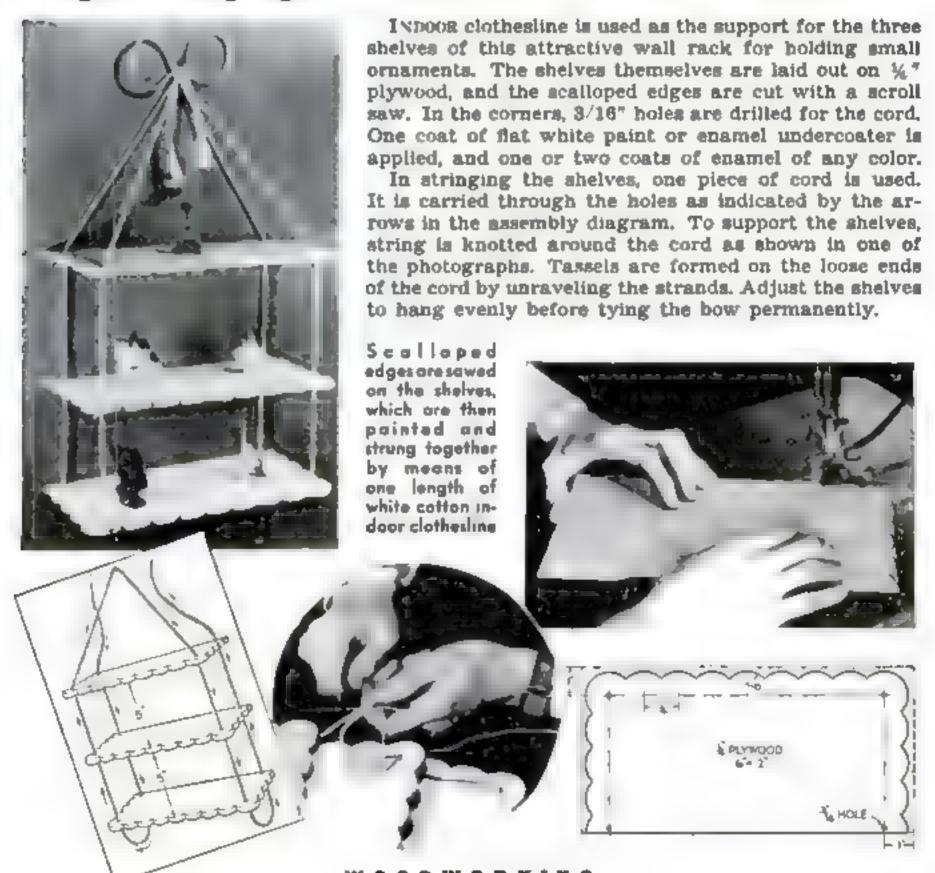
. . .

IN LAYING out accurate measurements on wood, it is best to make the marks with a knife or a rather hard, sharply pointed pencil. If the rule is old and worn, measure from the 1" mark rather than the very end.



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Light Hanging Wall Rack for Small Ornaments







The chest holds a lot of toys and there is a rock in the cover for story and painting books. The lid is upholstered in the simple way shown below

then made to fit on the upper edge of this box at the rear. It was doweled and glued in place, and a ½" board 5½" by 30¾" was glued over this.

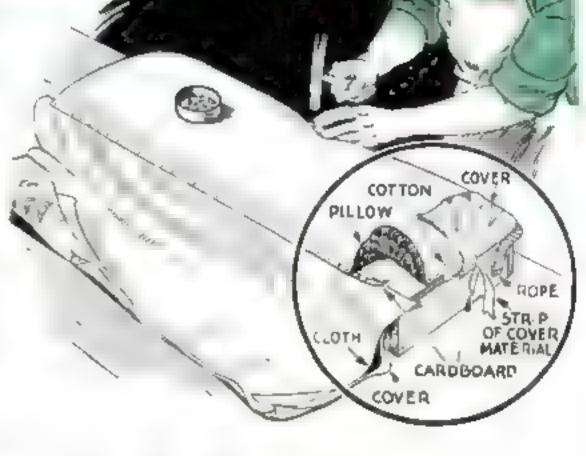
In making the cover frame, notice that the front piece overlaps the two sides and the back fits on the inside. The front is screwed and dowel-pegged to match the chest. A top ¼" by 11%" by 30%" is glued and nailed on. The bookrack is then added as shown.

The ornamental rail is shaped on the spindle shaper, but it could simply be beveled. The back and sides are mitered together. Cut the sides to the quarter-round shape indicated, and assemble with dowels.

Four handle brackets are cut from %" stock and given a molded or beveled edge. Bore a %" hole in the center of each for the rope handles. Screw the brackets from inside of chest, and use glue also. They are placed by " from the edges of the chest, front and back, and %" from the top. Do not add the rope handles until after staining and finishing the chest.

Maple stain is brushed on the wood and wiped off with a clean cloth. Allow this to dry overnight, then apply three coats of thin orange shellac. Rub with 3/0 steel wool. Add a hand-painted boat or a nautical decalcomania (transfer) if desired. Then polish the wood with furniture wax.

For upholstering, a nautical design in chintz or cretonne is used. The cloth, with the finished side down, is laid to overlap the back edge of the lid only 1". A piece of any ordinary cloth is laid on top of the upholstery material. Cut a 1/4" wide strip of

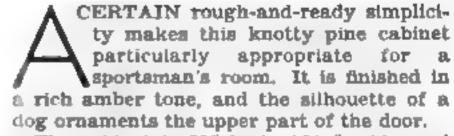


thin cardboard and tack to the very edge of the lid over the edge of the two fabrics.

A pillow is now sewed up to the width and length of the cover. Fill it with mohair and sew the opening. Let the two pieces of cloth dangle over the back of the lid and tack the pillow in place. A strip of cotton is next laid around the two sides and front to pad the sharp edge of the cover. The two fabrics are pulled over the pillow and tacked to overlap the sides and front 1".

Cut a strip of the upholstery material 1½" wide and long enough to go around the three sides of the lid. Cut a strip of cardboard ½" wide and fold the cloth around to make a binding. Tack this around to cover the tacked edges of the cloth. A %" white cotton marine rope is now nailed over the binding with 1" brass roundhead nails. Large scalloped upholstery tacks are nailed in at each end to cover the ragged end of the rope. Do the same at the bottom.

The cob net is 63" Gun Cabinet Gun Cabinet Gun Cabinet



The cabinet is 63" high, 16 1/2" wide, and 10" deep, outside measurements. Dimensions of all the pieces are given in the list of materials, and the parts have been lettered for ready identification.

Except for the plywood back, the cabinet proper is constructed of dressed white pine. The exposed parts are of a grade having sound knots; the gun rack and minor parts are clear stock. The thickness is nominally 1", but actually the wood is about %" thick. The widths can be changed slightly, if necessary, to suit the stock widths of the material available

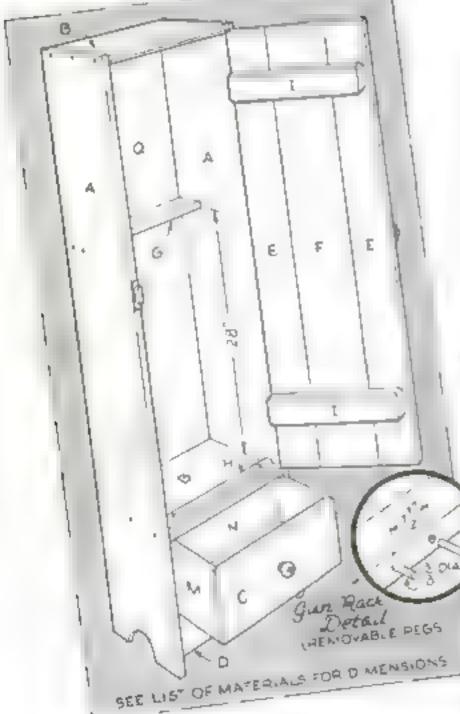
The rear edges of the sides A and the top and bottom B are rabbeted so that the ¼" thick plywood back can be set in. The dog silhouette (either design may be used) is

cut from %" thick pressed composition board and glued on. The gunrack G is bored for pegs, spaced 1%" apart. It is best to leave these unglued so that some may be removed as necessary when it is desired to store double-barreled guns.

The wood in finished with amber stain and thin coats of orange shellac, rubbed between coats with steel wool.





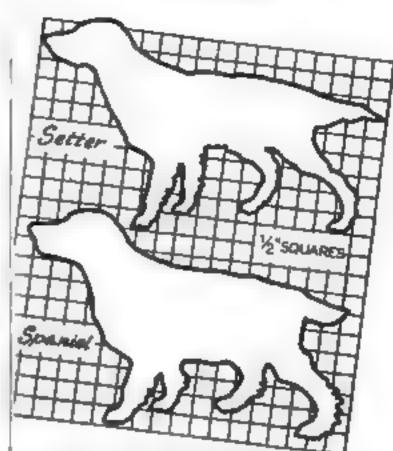


of Knotty Pine tom E. Moore Oswego State Normal School, Oswego, N. Y.

LIST OF MATERIALS

| Part Pc. Name Material T. W. L. | | | | | | | | | |
|--|------|------------|---------------|----------|------|------|-----|------|--|
| B 2 Top, bottom C 1 Drawer front D 1 Lower panel E 2 Door sides F 1 Door center C 1 Gun rack C 1 Gun rack C 2 Clear pine C 3 144 C 48 C 3 Gun rack C 4 Clear pine C 4 144 C 5 144 C 6 144 C 7 84 C 7 84 C 7 84 C 7 84 C 8 144 C 7 84 C 8 144 C 8 144 C 8 144 C 8 144 C 9 1 Cabinet back C 1 6 494 | Part | No. Pc. | Name | Mater | lal | T. | W. | L. | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | A. | 2 | | Knotty | pine | 1 | | | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | B | 2 | | ** | | 1 | | 14% | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | C | 1 | Drawer front | | - | 1 | 7 | 14% | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | D | 1 | Lower panel | 10 | 100 | 1 | 5 | 14% | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | 15 | 2 | Door sides | - 10 | No. | 1 | 4.6 | 48 | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | F | 1 | | - | 100 | ï | 5% | 48 | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | G | 1 | Gun rack | Clear p | ine | 1 | 8 | 14% | |
| I 2 Door cleats " 1 4 14½ J 1 Drawer stop " 1 1½ 13 K 2 Drawer slides " 1 1 8½ L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " 3½ 7 8½ N 1 Drawer back " 3½ 6 14½ P 1 Drawer bottom Fir plywood % 8½ 14½ Q 1 Cabinet back " " 16 49½ | H | 2 | Door stops | 11 | PF . | 1 | 144 | 14% | |
| K 2 Drawer slides " 1 1 8 % L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " % 7 8 % N 1 Drawer bottom Fir plywood % 8 % 14 % Q 1 Cabinet back " % 6 49 % | I | 2 | | 49 | | 1 | 4 | | |
| K 2 Drawer slides " 1 1 8 % L 2 Panel cleats " 1 1 4 M 2 Drawer sldes " % 7 8 % N 1 Drawer bottom Fir plywood % 8 % 14 % Q 1 Cabinet back " % 6 49 % | J | 1 | Drawer stop | - | | 1 | 11% | 13 | |
| M 2 Drawer sides " " % 7 8% N 1 Drawer back " " % 6 14% P 1 Drawer bottom Fir plywood % 8% 14% Q 1 Cabinet back " " 16 49% | K | 2 | Drawer slides | ** | 100 | 1 | 1 | 81/2 | |
| N 1 Drawer bottom Fir plywood 14 84 14 16 49 4 | L | 2 | Panel cleats | 94 | - | 1 | 1 | 4 | |
| N 1 Drawer back " " % 6 14% P 1 Drawer bottom Fir plywood % 8% 14% Q 1 Cabinet back " " 16 49% | M | 2 | Drawer sides | - | 19 | - 74 | 7 | 814 | |
| P i Drawer bottom Fir plywood ¼ 8½ 14¼ Q 1 Cabinet back ¼ 16 49¼ R 1 Dog silhouette Pressedwood ¼ 9½ 5½ | N | 1 | | 10 | 49 | 36 | 6 | 14% | |
| R 1 Dog silhouette Pressedwood 34 9 34 5 34 | P | 1 | | Fir plys | pood | 34 | 8% | 14 % | |
| R 1 Dog silhouette Pressedwood 34 934 534 | Q | 1 | Cabinet back | 41 | H | 14 | 16 | 49 % | |
| | Ř | 1 | | Pressed: | wood | 34 | 934 | 5% | |

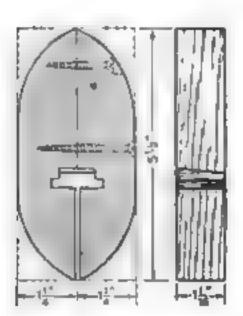
Note: All dimensions are given in inches.

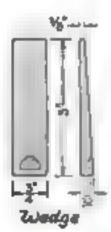


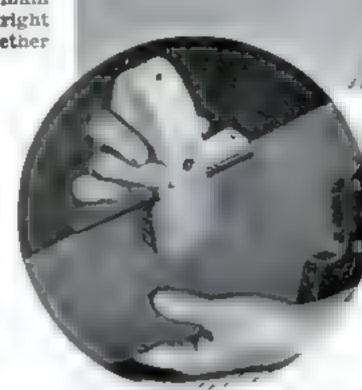
Either of these silhouetter may be used to decorate the cabinet

Gauge Simplifies Panel Marking and Saw Jointing

MADE on the circular saw in a few minutes, this hardwood gauge is used on a yardstick for marking panels and other large work. It also serves to hold a piece broken from a discarded file of about the same cross section as the yardstick so that the teeth of handsaws can be jointed easily to a straight line. Shape the parts as shown in the drawing below, but don't cut the bevel for the wedge slot until after the wedge is made. The slots can be cut on a circular saw. Be sure to make the two main parts of the gauge a pair, that is, right and left hand, so that they fit together correctly.—R. L.



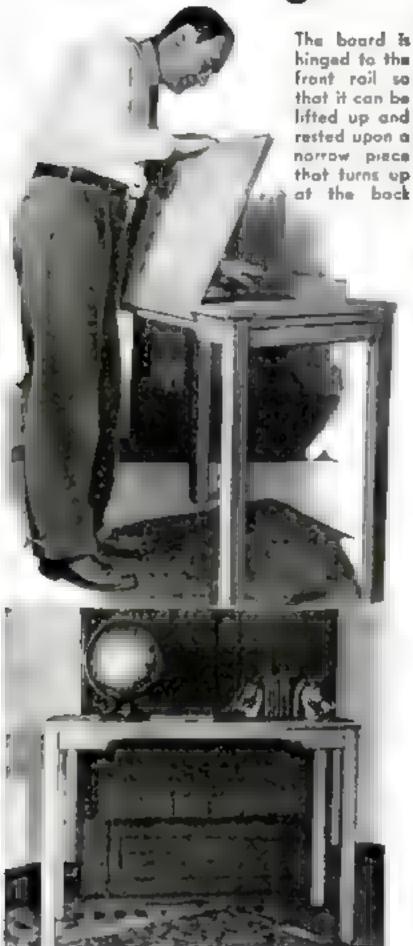


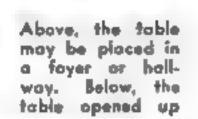


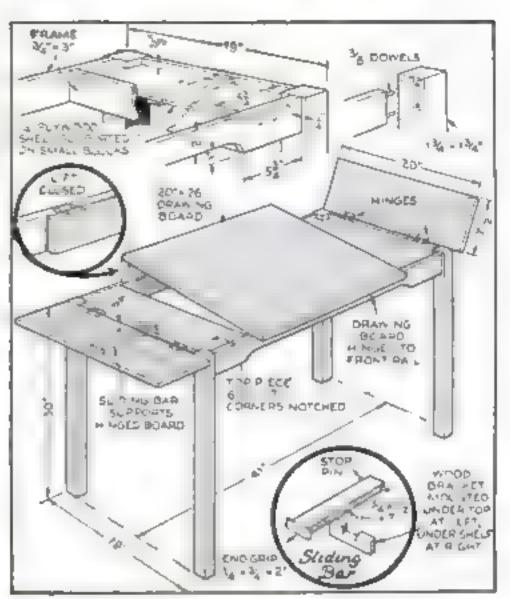
gauge and an ordinary yardstick to mork a measurement on plywood

To joint the teeth of a hondsaw, fit a prece of a discarded file in the gauge, as at left

A Drafting Table for Use at Home







ERE is a home drafting table suitable for a small apartment. When closed up, it can be placed in the foyer or hallway and looks like an ordinary flat-topped table.

The center section of the top is a standard drawing board purchased in an art supply store. The remainder is constructed from clear white pine. The only hardware required is four pair of brass butt hinges 2½" long and about 1½" wide when open.

Use a jig for lining up the holes in the rails and legs for the %" dowels with which the table is assembled. Before gluing, cut the front rail to the shape shown, and cut %" by 1%" notches in the side rails for the sliding bars. Use long bar clamps in gluing the frame and let it dry overnight before removing them. Next, mount the drawing board by hinging it to the front rail so that it can be lifted up from the back and rested on another piece of wood that is hinged to the back rail.

Sand the table thoroughly and either apply a stained finish or paint to match other furniture or woodwork in the room.—A. J. SODARO.

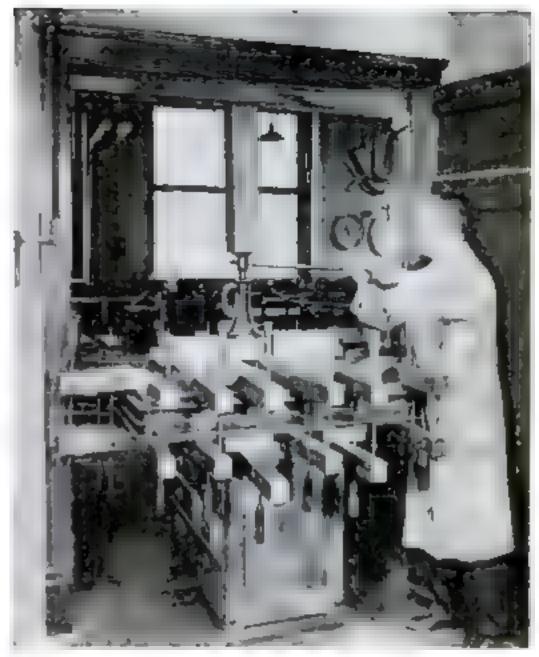
A 1-QT. CARDBOARD milk carton that has been washed out makes a good quart measure for use about the shop or home with oil and other liquids. The measure may be thrown away after use.—O. W. LYON.

Stripes of Paint Anchor Stop Nuts on a Drill Press

DRILL-PRESS stop nuts often loosen and work down the screw when the machine is being used for boring holes of uniform depth. This can be prevented by applying a stripe of varnish or paint lengthwise of the screw. When dry, it makes the nuts bind sufficiently to hold one in position long enough to drill two or three holes.

This procedure avoids the bother of running the lock nut down the screw and often saves considerable time.—L. K.

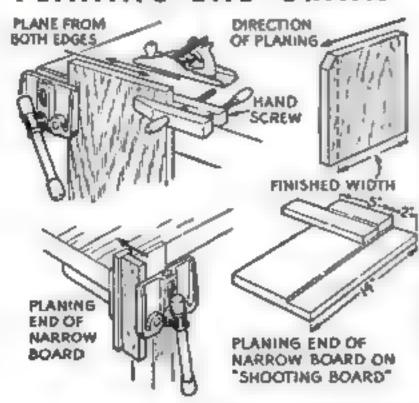




Jack Acts as Veneer Press

CONFRONTED recently with the problem of recovering a number of badly worn table tops with linoleum, I rigged up a large veneer press under a good-sized brick lintel." A house jack and a piece of 4" by 4" stock provided pressure at the center, and hand screws were used around the edge.—E. C. H.

PLANING END GRAIN



[WOODWORKING]

1. If the board is wide enough to be planed halfway from both edges, support the free end on the bench top by clamping a hand screw to it as shown. 2. If the board is narrow, but nevertheless wider than the finished width is to be, cut off one corner to prevent wood from splitting. 3. When the board is narrow and of the finished width, clamp another board behind it in the bench vise. A "shooting board" like the one illustrated may also be used in this case. Hold the board against the stop and use the plane resting on its side. A jack plane, smooth plane, or block plane can be used on end grain, depending upon circumstances, but for most small work the block plane is best,

POPULAR SCIENCE MONTHLY SHOP DATA FILE



PRING collets afford an accurate, convenient, and speedy means of holding drill rod and other finished bar stock in the lathe as illustrated in Fig. 1. They can easily be adapted to a precision lathe by the homemade draw-in chuck attachment shown in the accompanying photographs and detailed in the drawings at the end of this article. The drawings are exactly half the size of the attachment made by the writer for his own small lathe, but the dimensions obviously will have to be adapted to the lathe with which the draw-in chuck is to be used.

A collet adapter, draw-in spindle, and spindle cap (Fig. 2) are the parts needed, and these can be made on the lathe itself.

This particular attachment was designed for a 9" lathe with a 4," hole through the headstock spindle. The collets themselves may be purchased or made.

The handwheel in this instance was taken from a discarded valve. It was, however, given a finished appearance by being machined all over and polished bright. It was then bored to fit the hollow draw-in bar as in Fig. 3.

The hollow bar is a piece of cold-drawn seamless steel tubing 13½" long with an outside diameter of ¾" and an inside diameter of 9/16". This was chucked in the lathe to run dead true, and bored and threaded ¾"—26 threads on the inside to receive the end of the collet. The tube was

now placed between centers and turned smooth as illustrated in Fig. 4. The center section was relieved slightly in this operation to avoid any possibility of its binding in the headstock spindle hole.

For the next step it was necessary to fit the handwheel to the tube. To clear the gear guard of the lathe, the wheel had to be placed in back of a long collar. The collar was recessed to fit over the back end of the spindle as shown in the drawings. This recess accurately centers the outboard end of the drawbar when in use.

The collet adapter shown in Fig. 2 is best made from a short bar of tool steel. Turned to dimensions and finished on the outside, as in Fig. 6, it was cut off and inserted in the spindle hole of the lathe. Here it was drilled and bored as in Fig. 7, and then carefully brought to dimensions, that is, twice the size shown in the drawings. Great care was taken in the boring of this part, as the collet must be supported at each end only and have clearance in the center for spring. The accuracy of the whole attachment depends largely on the accuracy of the work

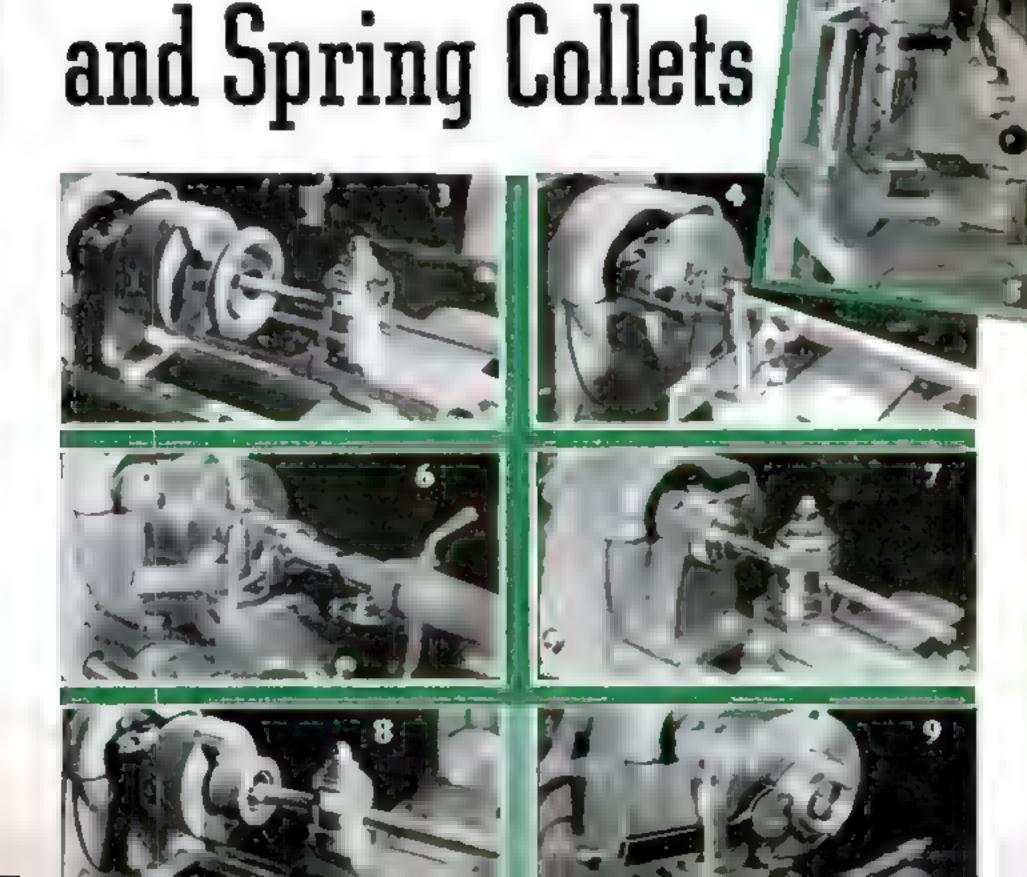
on the collet adapter. Every effort should be made to machine it perfectly.

A feather, as shown in the drawing, is needed to drive the collet, and the adapter was drilled as in Fig. 5 to receive it. Riveting this in place finishes the adapter, which is then ready to receive the collets. These may be purchased or made up by the method to be described.

The spindle cap, also shown in Fig. 2, was made 'o afford protection to the threaded end of the headstock spindle nose. A short piece of cold-rolled steel was chucked as in Fig. 8, bored, and threaded, the inside dimensions exactly duplicating those of the small faceplate that comes with the lathe. When threaded and counterbored, it was knurled while chucked as in Fig. 9. This finished the work on the attachment.

The spring-tempered collets are best made

from tool steel, hardened, tempered, and ground accurately to size. A set of eight, ranging in size from 1/16" to 1/4" by six-













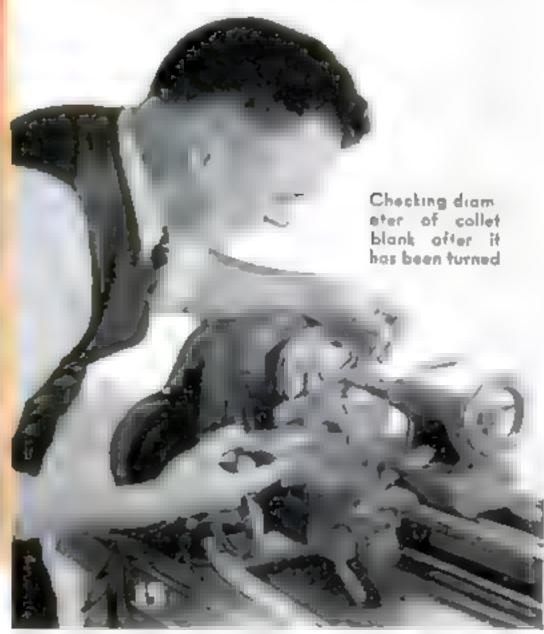
teenths, is desirable (Fig. 2). It is well to use a bar of steel slightly larger in diameter than the collet, and $\frac{1}{4}$ "longer. This makes the blank about $\frac{7}{8}$ " by 3", which is chucked as in Fig. 10 and centered on both ends

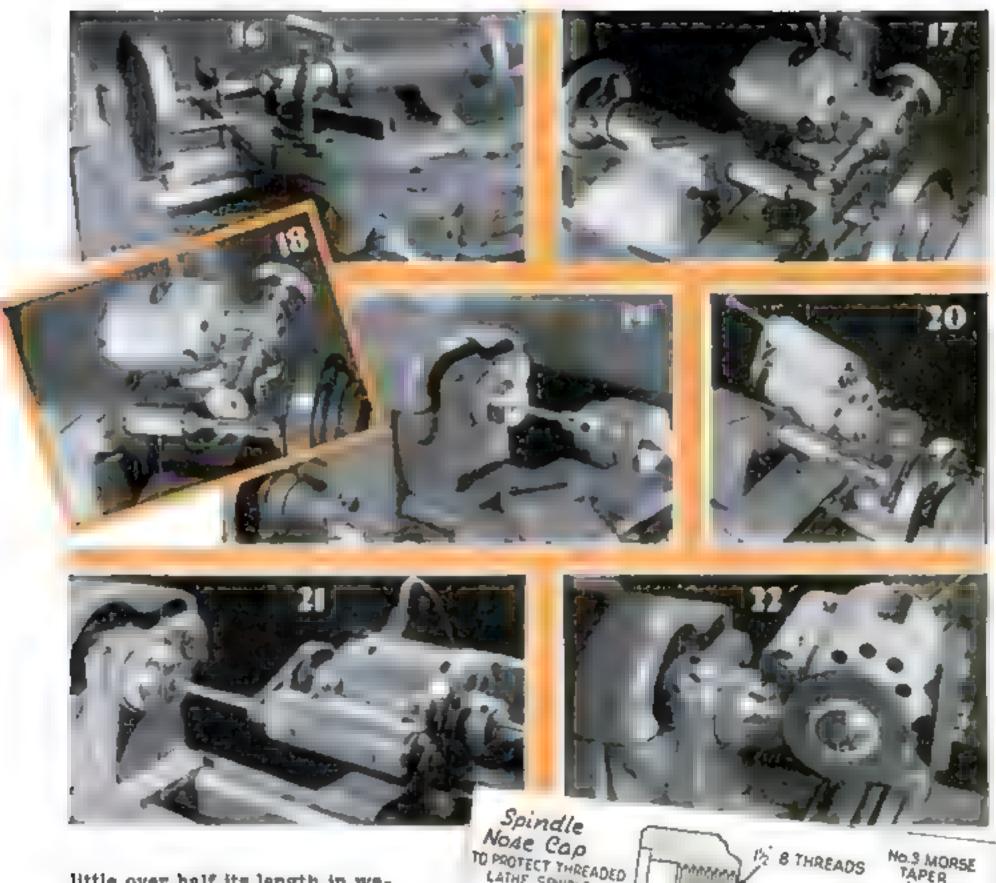
A roughing cut is taken before mounting the stock in the center rest, where the large clearance hole is drilled and bored (Fig 11). The outer end of the hole is beveled 60 deg. to receive the tailstock center, and the collet is turned to shape as shown in Figs 12 to 15. A slight allowance must be made for grinding to exact size after hardening

The %"-26 thread is cut on the end as shown in Fig. 16 to fit the threaded hole in the draw-in spindle. While still in this position, the keyway for the driving feather is milled as in Fig. 17, and the three slots are cut (Fig. 18). These slots are not cut through the center support left on the collet, but should be cut far enough out to clear the hole and far enough back to allow for spring in the collet. The metal-slitting saw should be thin and of small diameter

The collet can now be mounted in the adapter in place on the lathe spindle, as shown in Fig. 19, where the hole to receive the work is drilled slightly smaller than finished size to allow for grinding after hardening. The finished hole size should now be stamped on the end of the collet, and it is ready for hardening and tempering

If an open fire is used for bardening, it is best to place the collet in a metal tube and bring to a low red heat. Then plunge it a



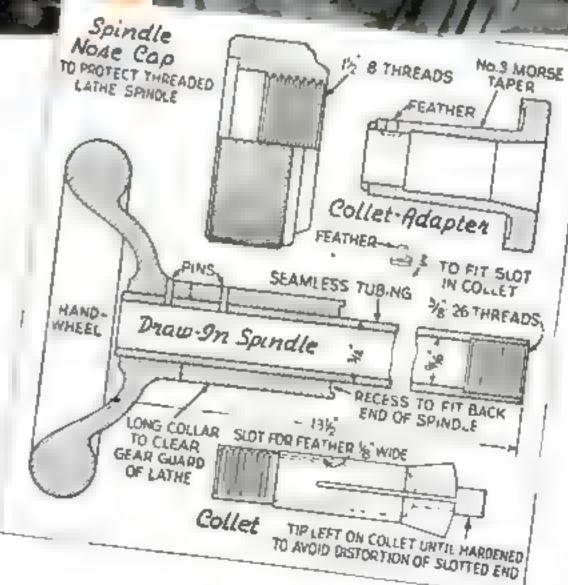


little over half its length in water. The temper is now drawn, and the collet is ready for grinding to finished size. This is done in the lathe with a tool-post grinder as shown in Fig. 20, or a hand motor grinder could be arranged to do the work.

In Fig. 21 the hole is being ground to size by the internal attachment of the grinder, which should be operated at the highest possible spindle speed. The lathe itself is run at a slow speed.

Figure 22 shows the center support being ground away. After being polished, the collet is ready for use.

The hole size of the collet should closely approximate that of the work to be held, and the collet should never be closed without work in the hole.

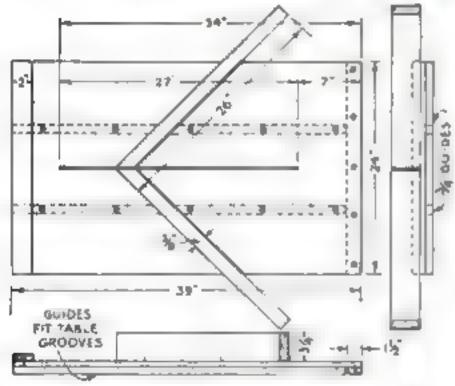


A Jig for Cutting Miters Speedily on a Table Saw



Maple strips underneath the miter board slide in the grooves of the saw toble and guide the jig as a miter is cut by the circular saw

Using the jig to cut a miter on a crown molding. A great many uses for the board can be found in a corpenter shop



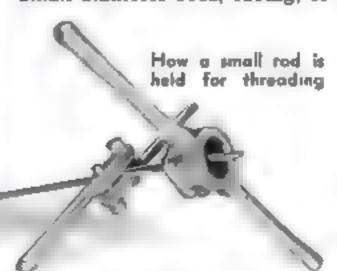
N A carpenter shop where a great many inside and outside miters have to be cut, the time spent in making this miter board for a circular saw will be saved over and over again.

The board is made of %" plywood with maple cleats at the ends, one on top and one below, as shown. Maple guides are fastened with screws through the top to fit the saw table grooves accurately. These should be so placed that the saw cut may be made in the middle of the plywood after the guides are in place by turning the saw up through the plywood. Fasten the fences accurately and strongly with screws from the underside after placing glue beneath the mitered ends.—Charles A. King.

Tap Wrench Holds Rods and Tubing for Threading



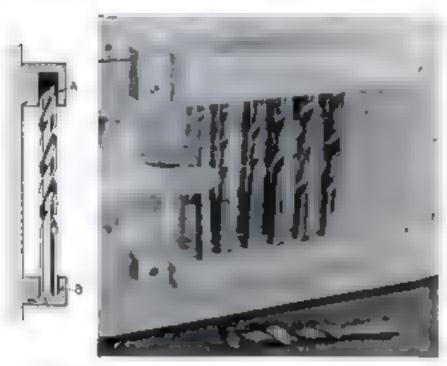
A TWO-PIECE adjustable tap wrench of the ten-cent variety is useful as an improvised vise for holding small diameter rods, tubing, or pipe for threading. It gets a good grip



gets a good grip without excessive pressure, and doesn't chew the stock up. I have even threaded %" iron pipe in this way without difficulty. The wrench can be carried in the pocket and eliminates the need of a heavy vise.—A. T.

Wooden Rack Protects Bits from Damage

For holding twist drills, auger bits, and other tools which should have their ends protected, a rack may be made of two strips of wood with holes bored as shown below. The strips are so spaced that when the upper end of the tool is pushed into an upper hole, the lower end can be swung in and dropped into a lower hole, yet the tool does not drop down so far that the upper end is released. To remove the tool, simply lift it up and swing the lower end out.



Rack made of parallel wooden strips having hales aligned vertically. Upper holes must be deeper

Two Small Tapered Parts Turned at One Setting

CONSIDERABLE time may be saved when turning several tapered parts for lathe fittings, handles, and the like if two are turned on one piece of stock. Separate the tapers after fitting to the socket. In the case of lathe fittings, insert the tapered shank in the headstock spindle to hold it while doing any additional machining.





Workshop Towel Hangs from Rubber Holder

IF A SHORT piece of radiator hose, cut as shown, is tacked on the wall of the workshop above the lavatory, it forms a quickacting holder from which the towel may be jerked carelessly without being torn.



Worn Grinding Wheels Cut into Tiny Ones

Tool-rost grinding wheels 1" in diameter and smaller are rather expensive in comparison with wheels from 4" to 6". When, therefore, bench grinder wheels of 4" to 4" face become worn too small to cut properly or are accidently broken, it pays to cut them up into small wheels. Chalk one side white, draw the desired circle with pencil, and drill the hole with a regular drill, but use water for a coolant. Shape the diameter with a bench-grinder wheel; then dress the small wheel as required.

Lathe Tailstock Arbor Holds Faceplate or Chuck

DRILL

005 HIGH

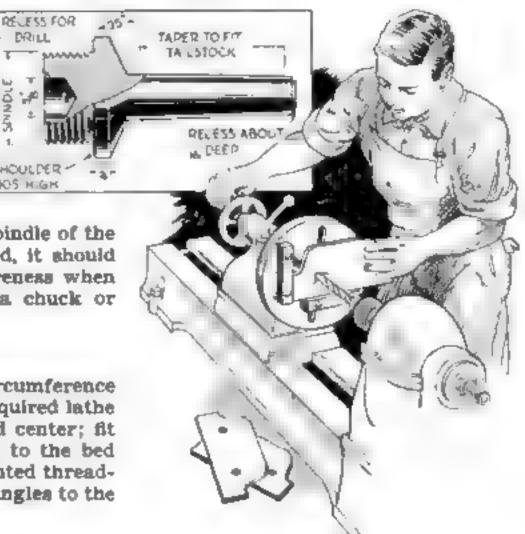
AN ARBOR of the type shown is a useful lathe accessory for holding a chuck or faceplate in the tailstock. It is handler than an ordinary drill pad because, when a faceplate is fitted to it, metal or wood pieces can be attached to serve as a jig for drilling duplicate pieces. The drill or drill chuck is held in the headstock spindle. The

special arbor should be finished in the spindle of the lathe. If the work is carefully executed, it should be true to less than 0.001" as to squareness when placed in the tailstock for mounting a chuck or

faceplate.—ELMER A. HUBBARD.

TO GRADUATE accurately the side or circumference of a handwheel or similar part, fit the required lathe threading gear to a suitably made head center; fit an indexing screw to a member bolted to the bed of the lathe, and scribe with a sharp-pointed threading bit set in a tool holder and at right angles to the

conventional position.—H. J. C.







Solder Coiled Compactly

A CONVENIENT way to handle wire solder, especially when it is necessary to get into tight places, is to roll it around a pencil, then pull the pencil out and push one end of the wire back through the center as illustrated at the left. Wind the loose end down around the straight end. As you use up the solder, pull the end out.-P. R.

INK FOR MARKING METALS

[FORMULAS]

| Gum arabic | 8 grams | Copper Sulphate | 20 grams |
|--------------|---------|---------------------------------|----------|
| Sal ammoniac | 16 " | Hydrochloric acid, concentrated | 10 cc. |
| Lampblack | 4 " | Water | 20 cc. |

Soften the gum arabic in the heated water; add the acid slowly while stirring; then the sal ammoniac; next the copper sulphate, and finally the lampblack. Apply with a fresh steel pen, a quill cut from a large feather, or a rubber stamp. Before using the ink, see that the metal is freshly polished, and clean it with denatured alcohol and a cloth.

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Brush Presses Inner Tube Against Buffing Wheel

In SEARCH of a convenient handle for holding inner tubes safely against a buffing wheel preparatory to patching them, one mechanic discovered that a discarded paintbrush was well adapted to the purpose, as illustrated at the right.

WHEN soldering the outside of the bottom and sides of milk cans, pots, pails, and the like, it helps to place an electric lamp beneath or inside the article. Any holes can then be readily seen.

Old Table-Lamp Standard Utilized as Lathe Light



AN OLD tablelamp standard. with base removed. was used for this lathe light. It was fastened on the back of the carriage with a small bracket. This type of illumination is most practical because the light moves with the carriage and therefore is always directed on the tool so the operator can see what is done. -D. D. FULMER.



The inner tube is held safely against the buffing wheel with the old of the old brush

Paper Glued to Thin Shims for Easier Handling

To LAY out and cut shims from very thin brass or steel, first glue a sheet of white paper on the stock. When dry, the stock is much easier to handle, and the holes and shapes can be marked plainly with a sharp pencil. The paper is removed after the shims have been cut by soaking them in water for a few minutes, then peeling it off.—Charles Homewood.

LUBRICANTS for Brilling, Counterboring, Countersinking [SHOP METHODS]

| MINUSIAN DEING | SUITABLE LUBRICANTS | | | | | | | |
|--|---------------------|------|---------|---------|----------------|----------|------------|----------------|
| MATERIAL BEING WORKED | Dry | Milk | Lant of | Paratin | Soap maxime | Kerosene | Turpentine | Boda Wateri |
| Aluminum Babbitt Brass Bronze Cast iron | XXX | | x | x | | х | ж | X |
| Copper | | X | | | | | 200 | |
| Glass Hard steel High-speed steel | | | 100 | | | x | X | x |
| Lead Machine steel Maileable iron | | | X | | x | | | X |
| Monel metal Soft alloys (of aluminum, etc) Soft steel Wrought iron | | | X X | | x | x | | X X X |

Water 2½ pt soft soap. 1 os sodiem carbonate. I or lard oil 1 os. Mix and boil forty minutes before using 5 Sodium carbonate 'sal soda washing soda etc.) in water. The sodium carbonate used by photographers will do. 2 Dissolving camphor in the turpentine will improve the action in drilling glass.

1 Use allow speed in drilling

Note Never use lubricating oil on a drill hit.

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Painting Questions



FROM ASBESTOS SHINGLES

My new asbestos shingle side walls have a drip stain here and there under window zills. I have tried to remove these with gasaline, but with no effect. What should I use?

Use one cup of trisodium-phosphate powder to a pail of hot water. Scrub the stained area thoroughly, then rinse with clean water and a sponge

WHY OUTSIDE PAINT CHECKS

Last year we painted our house blinds, and now they are badly checked and alligatored. Did the painter use too much drier, or what is the trouble?

It is possible that too much drier was used, but it is much more likely that a hard-drying paint was applied over a soft coat,

in which case alligatoring or checking always occurs. The use of prepared paints over lead and oil will cause the same thing. Either system, however, is good when used throughout.

The only practical method is to strip the blinds in a tank of boiling trisodium-phosphate solution, using a pound to a gallon, and scrub them clean with a palmetto fiber floor scrubbing brush. Hose off with clean water, let dry thoroughly, sand where necessary, and repaint with the new, nonfading type of outdoor enamel intended for trim and trellises. Two coats will be required.

WHAT TO USE FOR RUBBING

I notice that you, specify the use of FFF pumice stone and crude oil for rubbing varnish. I have always used rottenstone and linseed oil. Which is better?

FFF pumice stone and crude oil or light golden paraffin oil do a better and faster job than does rottenstone. The latter is too fine and too slow for anything except pollshed planos, which, by the way, are seldom polished as in the past. Linseed oil should never be used in rubbing as traces left in corners dry to a sticky mass that is hard to remove. The crude oil or paraffin oil is easy to remove with a stiff brush and a mixture of one part oil and two parts gasoline. Wipe clean.

PAINTING WITHOUT DRIPS

I have been decorating my living rooms with the new type of water casein wall point. I find this material most satisfactory, but the brush drips badly, especially on overhead work. How can I stop this?

Master painters frequently give their mentwo 6" brushes for this work, only one of which is used at a time. One brush is dipped 1½", spatted against the inside face of the pail, and then used to brush overhead. This is continued until the brush starts to leak, at which time it is wiped across the edge of the pail until clean. It is then hung on the pail with a hook, and the work is continued with the second brush.

In lieu of a second brush, get a child's rubber ball, cut it in half, punch a hole in the crown side, and slip tightly over the brush handle with the hollow side facing the bris-

BY RALPH G. WARING

tles. The cup thus formed will stop leakage if wiped out from time to time.

REMOVING OLD CALCIMINE

I recently purchased an old New England farmhouse, which I wish to remodel for a summer home. The interior walls, while sound, are covered with calcimine or whitewash, but I want to give them an eggshell oil-paint treatment. How should they be prepared?

This work is best done by two people, one of whom uses a pail of warm water containing a cup of vinegar to sponge and wet the surface thoroughly. The second person follows within a few minutes and uses a palmetto brush and a pail of water containing one cup of trisedium-phosphate powder to loosen and wash off all traces of whitewash. A wide putty knife may prove of value in speeding up the work. Let all surfaces dry with wide-open doors and windows.

Cut out any cracks or dents and repair

KEEP BRUSHES OUT OF WATER

Recently I read that many painters keep brushes soaking in water when not in use, but isn't this very harmful to the bristles?

Whoever wrote that ought to be tined \$50 or given

six months in jail! Suspend occasionally used paintbrushes in a mixture of half pure turpentine and half pure raw linseed oil so that the bristles remain straight and hang clear of the bottom of the container by at least 1". Wipe such brushes dry before using. They will keep in perfect condition. Water, on the other hand, makes the bristles soft and flabby.

PAINTING RESINOUS WOOD

Here in the south we have trouble with pine resin streaks showing up on our outside trim. The paint cracks like an alligator's skin and is now peeling off How can I cure this?



Have a reputable painter burn off the broken-down coats after you have obtained written permission from your

fire insurance company to do this work. Without this permit you take a chance on having all your fire insurance invalidated.

This burning is necessary, first, to remove the old paint, and second, to draw out the excess resin from the wood. Sand the trim. Prime with aluminum bronze of the varnish grade, using 2 lb. of bronze in 1 gal. of outside spar varnish. Wet the bronze to a paste with turpentine before adding the varnish. Brush out well, dry hard, and then give two coats of first-quality paint. Sand the first coat lightly when dry

with patching plaster. Dry hard and cut down with No. ¼ abrasive paper until level and smooth. Then proceed to use the eggshell wall paint according to the manufacturer's directions.

PRESERVING COPPER SCREENS

A previous tenant painted our copper screens black. How can I get this off? We live near the seashore, so what should I do to keep the copper from turning green?

Lay the screen down over a sheet of metal or any building board that has been given a coat of hot paraffin to stop absorption. Use a heavy bodied or marine-type varnish remover on the screen wire. Apply with a slow, flowing motion in one direction only;



WATER USED FOR FINAL RUB

Why do you use wet cotton waste for a final rub after crude oil and pumice stone?

The use of clean, white cotton waste or a piece of wrung-out cotton fiannel to clean up and polish after oil rubbing is a long-established practice in the coffin industry. This method produces a rich, semipolished sheen not obtainable in other ways and removes any "stop marks" left by the felt rubbing pad. Rubbing pads used with oil should never be used afterward with water or they will become hard and glazed. If that should happen, soak the pad overnight in gasoline and clean with a dry scrub brush.

let stand ten minutes, test with the finger to see if the finish is cut down to the wire, then scrub loose with an ordinary palmetto brush. The wire must press against the backing material throughout because copper or bronze mesh is too soft to stand unsupported pressure.

Turn the screen over and repeat the process very carefully to prevent springing the wire. Give a final wash with another scrub brush and denatured alcohol. Clean up the frames as well. Let dry overnight, then give a light brushing, from both faces, of outside spar varnish. Blow out any places where the varnish has bridged the meshes. The metal will not be corroded by sait air.

PREPARING A PLASTER WALL

We are planning to wall-paper several rooms in our new home, but have been warned that the plaster may be too fresh and that this might cause discoloration or other trouble later on. Is there any way to test the plaster?

Before wall paper is hung on a plaster wall it is important that the plaster be in good condition without "hot spots" caused by excessive lime. If in doubt, apply a five-percent solution of phenol-phthalein, which can be obtained at a drug store. If this chemical causes a stain to appear, ranging in color from pink to deep red, the plaster requires to be neutralized before any paper can be safely hung. This can be done by using a solution of from 2 to 4 lb, sinc sulphate to a gallon of hot water.

After the wall has dried it must be properly sized. In case the plaster was found to have an excessive amount of lime or is otherwise in doubtful shape, it is best to prepare a special size as follows: eight parts ordinary commercial wall-paper size or give size, one part molasses, and one part vinegar. Heat, stir well, and apply to the wall while hot. Another point to remember is that whenever a high-grade, expensive paper is used it pays to apply a lining paper first.

RICH STAIN FOR MAHOGANY

How can I give a Colonial mahagany finish

Usually this is a deep mahogany color of rich, reddish tinge. First stain the wood brown mahogany, let dry, and rub with 6/0 garnet finishing paper; then apply a coat of red mahogany stain. Fill the grain with paste filler tinted red mahogany. Apply one coat of high-grade four-hour floor varnish thinned with an equal amount of turpentine, and follow with two or three coats of full-body varnish. Rub to a semipolish with FFF pumice stone and oil.

REMOVING PAINT FROM GLASS

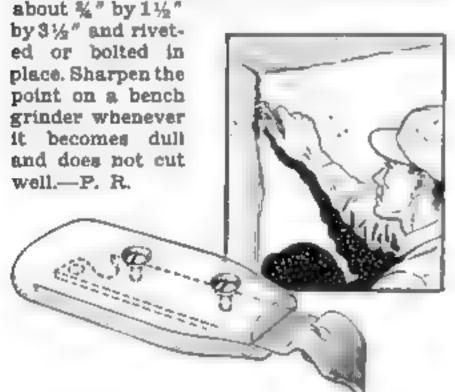
What is the easiest way to remove a pointed sign from a window?

Make up a paste of 1 lb. of ordinary whiting and a small quantity of water containing all the washing sods it will dissolve. Apply this paste freely to the painted letters on the window. Leave it on until the letters are quite soft and can be cleaned off with a wad or roll of newspaper. Emergency Work Flag Set Up on Shovel

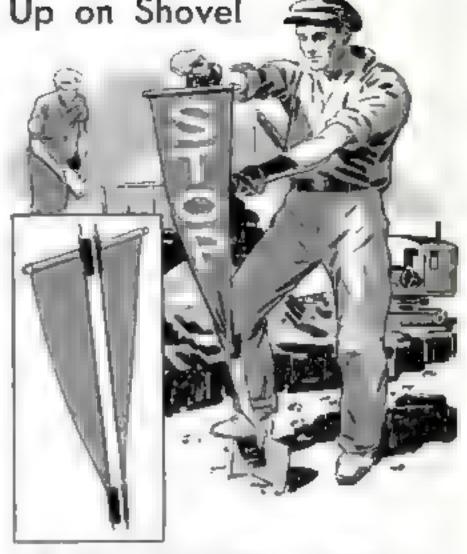
"WARNING" or "stop" flags are easily carried on construction jobs for emergency use if made as shown. Short sections of radiator hose, slit open at one side, are attached to the crosspiece and tip of the flag. These grip the handle of a long-handled shovel, which may be stuck into the ground to serve as the supporting staff.—G. H.

Tool for Cleaning Out Cracks in Plaster

Before patching long, narrow cracks in plaster walls such as those that often occur in the corners of a room or along the base-board, it is necessary to widen them, clean them out thoroughly, and undercut the edges a little. This can be done quickly and easily with a crack-opening tool made as shown below from an ordinary beer-can opener. The handle is shaped from a soft pine block



A wooden handle is bolted to a beer-can opener

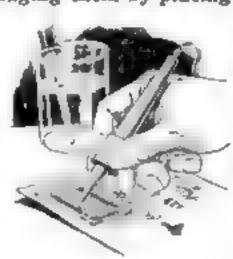


The flog is held with pieces of radiator hase

Removing Stamps Quickly

STAMP collectors can remove stamps almost instantly from envelopes without running any risk of damaging them by placing

several drops of water so as to form a little pool over the entire surface of the stamp and then heating the water with an electric burning or pyrographic pen. This quickly softens the mucilage, and the stamp comes off.

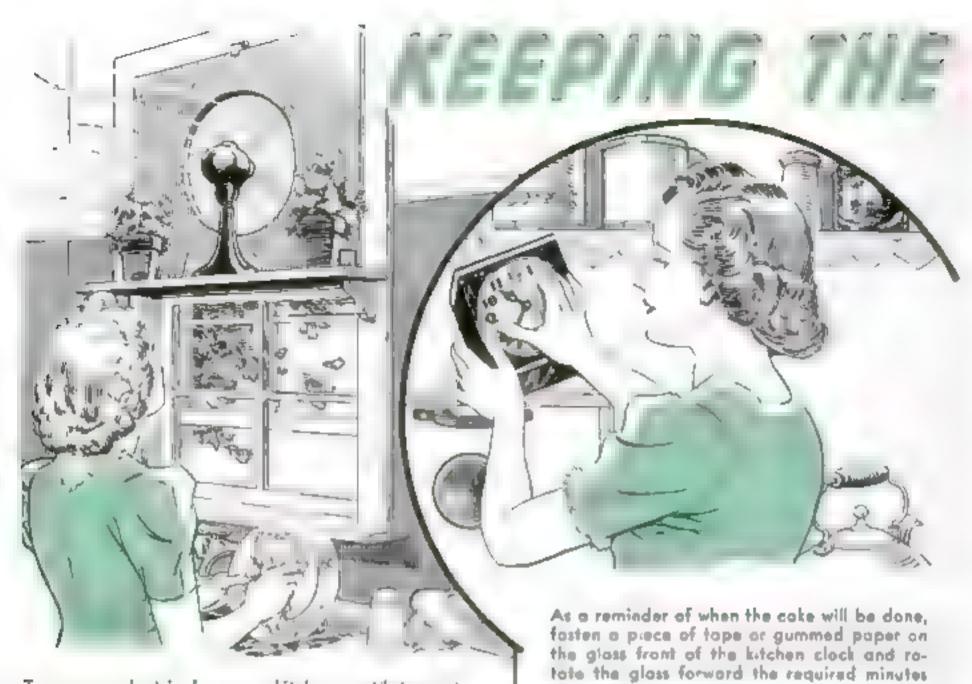


Casein-and-Whiting Cement Fastens Small Handles

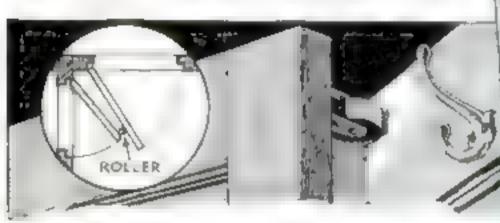
When a knife, tool, or other small implement must be replaced in its handle, a satisfactory and easily prepared cement consists of one part each of waterproof casein glue and whiting. The glue gives the compound an adhesive and waterproof character, while the whiting provides bulk and lessens the tendency to shrink.—O. B.

If you standardize on 12" hack-saw blades of the hand style and make a habit of using the forward 6" until worn, then the remainder of the blade, you will get much longer life out of each blade.





To use an electric for an a hitchen ventilator set a plywood panel with a hole I" larger than the fan diameter between the window trim and a cleat on the shelf. A cotch holds the panel at the top

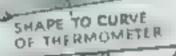


When two doors open against each other a small rubber wheel attached to the top corner of one door prevents the knobs from scraping the panels



Cellulose-base linoleum coment can be prevented from drying and cracking after it is applied by adding 1/2 az. castor ail to 1 qt. coment. Even after it has dried, it may be bent like celluloid

A spring clothespin makes an excellent clomp for a tubular type candy thermometer. Wet the twine before wrapping around clamp and tube



NOTCH FOR

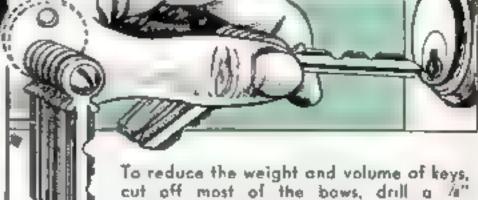
If oil occasionally drips on the floor from the motor of your electric washer, wire the metal lid from a large pretzel or lard can to the legs

HOME SHIPSHAPE



Powdered graph to obtained from the lead of an ordinary penal makes a good tack lubricant. It may be blown in if no ejector is available.

Precious stones can be cleaned with tooth paste.
Apply the paste (any popular brand) with an old toothbrush and rinse the stone in running water



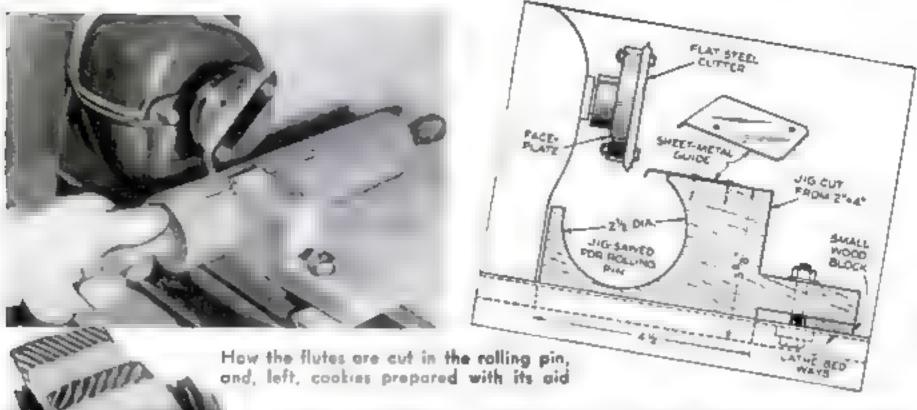
hole, and hold together with a small balt

SEPTEMBER, 1940

THE HAMBY MAN

161

Fluted Pin Rolls Fancy Cookies



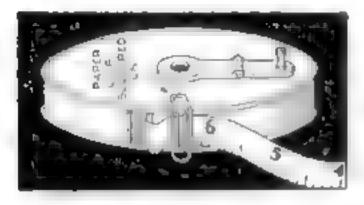
pared with a fluted rolling pin. The one shown is an ordinary rolling

pin, 2½" in diameter, which was fluted with a cutter made from a piece of flat steel 3½" by ¾". The ends were ground to the shape shown, and the cutter was mounted on the faceplate of the lathe. A jig to hold the rolling pin in position under the cutter was cut from a piece of 2" by 4"

stock. Note the sheet-metal guide attached to the top of the jig. One end was bent over so it would fit in a groove already made and assure even spacing.

A line was marked along the pin for the first groove. The lathe was started, and the pin pulled forward slowly as the cutter ploughed out the groove. The other grooves were automatically spaced by the sheet-metal guide.

For best results in making cookies, a very short dough with little or no leavening should be used.—BENJAMIN NIELSEN.

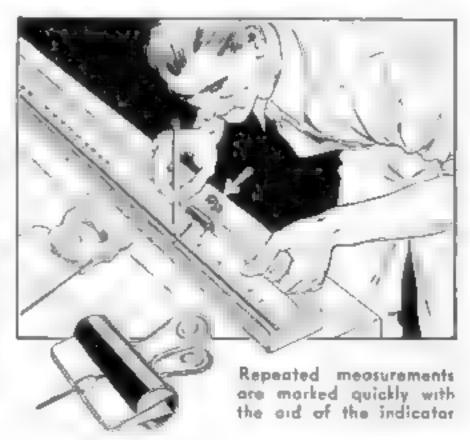


Clip Keeps Tape from Unwinding

To APPLY a restricting brake on your tape line and prevent it from unwinding too easily and tangling, bend a wire paper clip at a right angle and solder it on the side of the reel box. It is an easy matter to slip the tape under the clip and hold it at any desired length.

Foolproof Length Gauge Clamps on Yardstick

For marking lengths or transferring measurements when cutting wood stock, I find it easier, faster, and more accurate to use the sliding indicator illustrated. It is a common spring paper clip to which a slender brad has been soldered. The indicator can be clamped over a yardstick or any thin strip of wood. Three or four of the clips may be set along a rule or stick when you wish to record several measurements. Where inside measurements have to be made and you must telescope two shorter sticks, these form bandy non-slip clamps.—RALPH C. Cox.



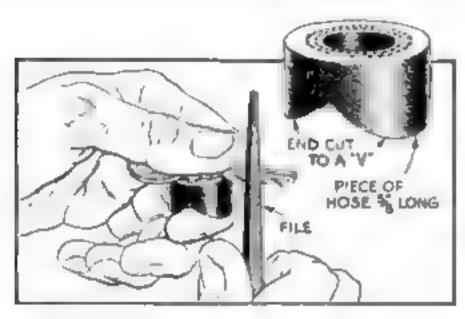
Arms of Easy Chair Re-Covered with Cloth Taken from Back

When the cover material on the upholstered arms of your favorite armchair has worn through while the rest of the chair remains in good condition, you do not necessarily have to go to the expense of re-covering the entire chair. Almost always, the rear of the chair back is covered with a large panel of the same material, and this is enough to re-cover both arms.

First, a narrow fold is turned to provide a strong finished edge, which is fastened with gimp tacks along the outside underedge of the arm roll. Next, turn the piece of cloth up, over, and down the inside surface of the arm. Carefully fold and fit it over the front end of the arm, and tack down along the rear outside edge of the vertical part of the arm. After the cloth has been pulled down smoothly, the lower inside edge is stitched to the original covering, and the back edge is tucked into the space where the arm meets the chair back.



A piece of cloth of suitable color is afterwards tacked on the chair back where the original cloth was removed.—H. O. BUMANN.



Short Section of Hose Used as Finger Vise

MANY small flat pieces that have to be shaped or finished by filing can be most conveniently held in the fingers with the aid of a section of air hose or heavy water hose about %" long. Cut a V into one end of the tubing to fit over the tip of the forefinger, as shown above.—F. B.

Keeping Dial Phone in Place

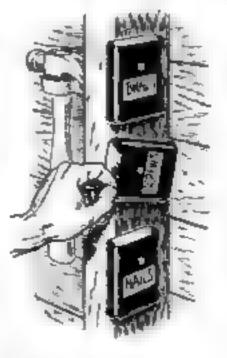
DIAL telephones have an aggravating habit of slipping on a polished desk when you are dialing, thus turning a one-finger job into a two-handed one. Mine used to do this until I brushed a little paper cement (white rubber cement) on the felt on the bottom. Now the phone stands as if bolted to the desk.—E. C. Brown.

Nails Stuck to Hammer for Starting

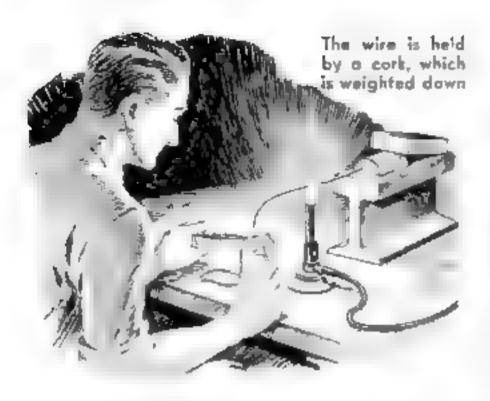
A GOOD trick for starting nails where it is inconvenient to hold them, is to rub a little beit dressing on the side of the hammer head. The nailhead adheres to this sufficiently to remain in place for the first blow, with the hammer held sideways,



Nail and Screw Holders



To KEEP odds and ends of nails and screws at hand in a barn, garage, or workshop, cut the tops from a number of tobacco cans and nail these onto the side of any studding. Place the supporting nails somewhat above the middle of the cans. The contents are made accessible by tipping the cans forward.



Tiny Articles Soldered by Using Hot Wire

VERY small articles, such as tiny links of white-metal costume jewelry, can be soldered neatly with ordinary soft solder as shown above. The 14-gauge copper wire takes the place of a soldering iron, and the heat is regulated by moving the Bunsen burner. When the end of the wire is hot, soldering paste is applied and a warmed piece of wire solder is touched against it so as to leave enough for joining the parts.—F. D. M.



Percolator Serves as a Gluepot

A DISCARDED electric coffee percolator can be used as an electric gluepot. Place the inner part of an ordinary gluepot in the open top of the percolator to hold the glue. The water heats it quickly.

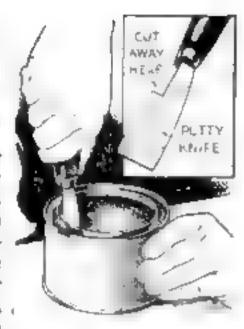
Repairing Rusted Feet of Old Laundry Tubs

When the angle-iron legs of laundry tubs
rust away at the base, scrape all the scale
off, place a conical sheet metal mold around
the leg, clamp it shut, and fill with molten
lead as at the right. Then strip off the mold. In
some cases it may be necessary to drill holes in

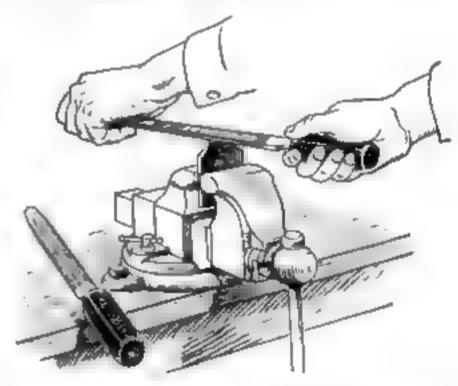
some cases it may be necessary to drill holes in each of the tub legs to provide a strong key for the lead.—Howard Lewis.

Putty Knife Is Altered for Scraping Cans

REMOVING the contents of the common type of small paint can or any can having an edge turning inward will be easier if you cut or file away part of an ordinary putty knife

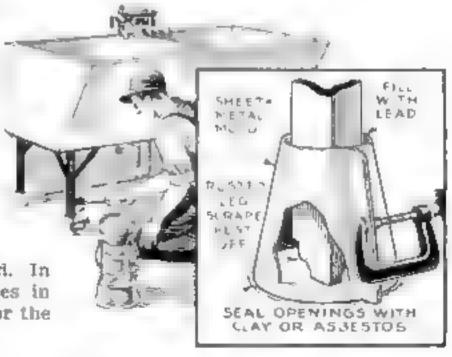


near the handle as shown in the sketch above. The knife reaches into every corner. It is also a handy implement for mixing the can's contents.—STAN HUGO,



Rubber Handles Improve Files

RUBBER bicycle-pedal treads, obtainable from a bicycle supply store or taken from an old bicycle pedal, make excellent file handles that will not come off in use, yet can readily be removed. The rubber is sufficiently flexible so that the file can be held easily in unhandy places and is less tiresome to grip.—Koudy Kennon.





By HI SIBLEY

These fine gaggles were made by a Hawaiian. Experts consider this type more satisfactory for serious diving and continuous use than the ardinary rubber variety

SOUTH-SEA

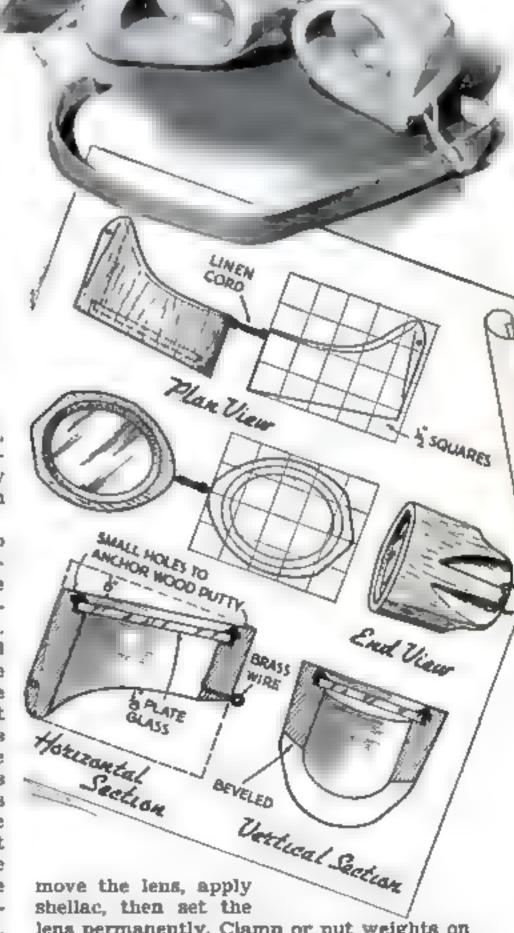
Diving Gogles

JTH a little care and patience, you can construct diving goggies exactly like those used by the spear fishermen of the South Seas and expert Hawaiian divers.

Any nonporous hardwood not likely to split may be used, but it must be thoroughly seasoned. The goggles shown in the photographs were carved from "hau" (pronounced "how"), a wood available in Hawaii.

Cut two blocks 2" by 2" by 2", and bevel the front surface of each on an angle of about 8 deg. Then bore and file out the openings as shown. Carve a rabbet or seat for the lenses, which are plain plate glass about %" thick. Any glazier will cut these for you. In making the seat, try to get as perfect a fit as possible. By coating the lens with lampblack and pressing down on the seat, high spots will be revealed. Do not mount the lenses until the outside of the wood is shaped to its final form, and the small brass eyes for the cord have been inserted in their holes and clinched inside.

Apply shellac on the lens seat, then a thin layer of plastic composition wood. Press down with the lens to smooth the paste. Re-

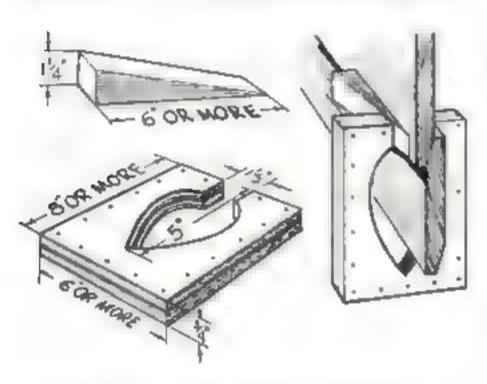


lens permanently. Clamp or put weights on the lens to hold it firmly until the shellac dries. Finally, apply composition wood around the edges on top, as shown. If small, shallow holes are first drilled around the inside, they will serve to anchor the

plastic material more firmly.

The rim that fits around the eye should be beveled carefully so that the pressure will be equal all around. The flesh will yield enough, if the wood is properly fitted, to form a watertight joint, Give the wood two or three coats of shellac all over.

To prevent fogging in use, soak the goggles in water of the same temperature as that in which they are to be used. Wet the skin around the eyes and press the goggles on to create a partial vacuum inside. This will make the eyes feel a bit queer, but does not hurt. The proper spacing of the two members can be determined by experiment.



Boat-Planking Clamps

IF YOU do not have enough large screw clamps to hold the planks while fitting and riveting a small lapstreak boat, make up a dozen wedge clamps from two layers of %" plywood as shown above. The inner portion of the jaws is sawed larger so the clamps can be used on curves.—J. W. RANKIN.

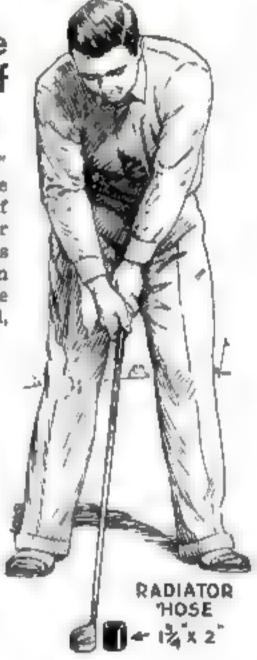




A fairly tight rubber band keeps the goggles on

Radiator Hose Used as Golf Practice Ball

A 2" PIECE of 1%" radiator hose may be used for practicing golf shots, either indoors or outdoors, with all clubs except the putter. When hit, it gives about the same feel as a golf ball, and it reacts to the way it is hit much as a regular ball does. A perfectly hit shot wid make it fly true and straight, whereas a poorly hit one causes it either to hook or slice. If hit underneath, it popa up, and topping will makeit akitter over the ground for some distance. -LOUIS R. JAFFEE.



Grinder Set on Tractor to Sharpen Farm Tools

ONE farmer attached a grinding wheel base to his tractor as shown at the left. This required but little more labor than squaring the end of a block of wood to fit one of the regular sockets provided for attaching cultivating equipment. Powered from the belt pulley of the tractor, the grinder is useful for putting mower knives, cultivator shovels, and plowshares in good condition, as well as for other odd jobs.—ROYCE M. ROATH.

Hikers' Lightweight Tent Pegs Cut from Bamboo Poles

HIKERS, canocists, and cyclists who carry featherweight shelter tents on their trips can make a very light yet surprisingly durable set of tent pegs from bamboo as shown in the drawing at left below.

A bamboo pole about 1 % " in diameter is the best size to use. One can often be obtained from furniture stores, which receive them in shipments of rugs. Cut the pole into sections by sawing about 1 % " above each joint; then split the sections in half. Start the notches below the joint with a saw, then cut them out with a knife; finally, taper the other end. If hamboo smaller than 1" is

used, it is best not to split it, but to use the material in the full round at the head.

Each bamboo stake weighs but a few ounces and the whole set adds very little to the weight of the pack,—CARROLL, E. BRADBERRY.

Shoes for the Beach Fashioned Out of Old Inner Tubes

BATHING shoes for walking on scorching beach sand are easily made from a discarded automobile inner tube.

Draw the outline of each foot on cardboard and use it as a pattern in cutting the sole. Each sole is made of three thicknesses of rubber. The crosspieces are cemented in place with rubber cement after two thicknesses of the rubber sole have been cemented together. The length of the crosspieces is best determined by plac-

ing them across the foot in their position.

The back part of the shoe is anchored by cementing a short loop to the heel as shown.

Extra rubber cementrd on the fixel makes
the shoes more comfortable for walking

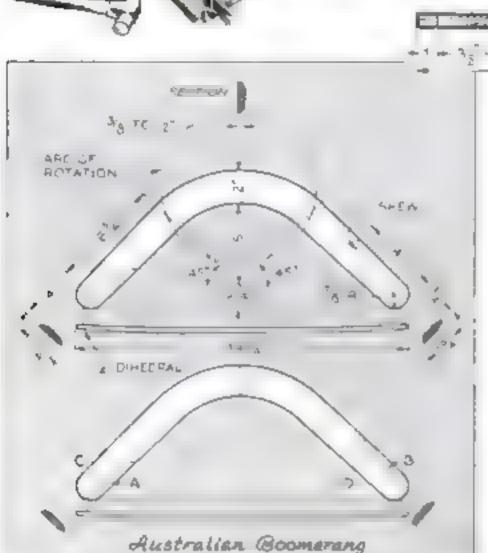
A rubber strap passes through this, crosses in front of the foot, and is attached to the crosspieces.—FRANK CAPORAEL.

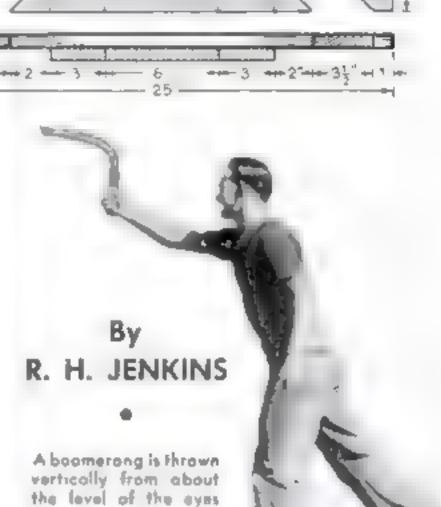


Vine Awning Changes with the Seasons

WHEN the cloth on one of our awnings needed replacement, I covered the framework with '4" mesh hardware cloth and allowed a climbing vine to cover the acreen completely. This awning may be called "automatic" because it changes with the seasons, growing dense in the summer and practically disappearing in the late fall when the leaves drop off. It does not, of course, have to be taken down.—A. J. VIKEN.

Boomerangs...How







Flot and rounded sides of a boomerang made by gluing up thin strips in the jig shown at top of the page

T'S GREAT sport to throw the Australian bushman type of boomerang, but its construction has always been a problem because of the difficulty of bending the wood. A simple solution is to glue up the boomerang from a number of layers of thin wood in a form or jig made as shown above.

Any wood will do for the jig, but be sure that the two curves are parallel when they are 2½ apart. For each boomerang cut eighteen pieces of oak or maple ½ by ½ by 28. Apply waterproof casein glue on each piece, clamp the whole mass in the jig, and let dry.

Plane the bottom smooth, cut out the shape, and round off the top to about 'y" maximum thickness in the middle and ', " at each end. Bend up both ends by heating the laminated wood on top at the 6%" points and bending toward the heat; this gives the required dihedral angle or upward bend of about '%". Skew off with a spokeshave the points marked A and B—from 1/32"

to Make and Throw Them

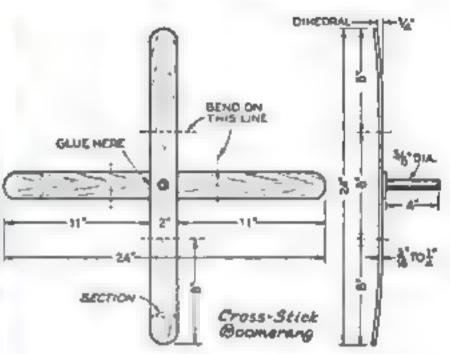


can be caught upon its return by means of a handle

to 1/16" should be enough. For a lefthanded person, the

points must be reversed and the corners taken off are then at C and D.

Throw vertically, never horizontally, and at about the level of the eyes. Hold the boomerang at end B unless you are lefthanded, in which case hold it at end C. Be



sure to keep the curved face in toward your body. The throwing should be on soft ground.

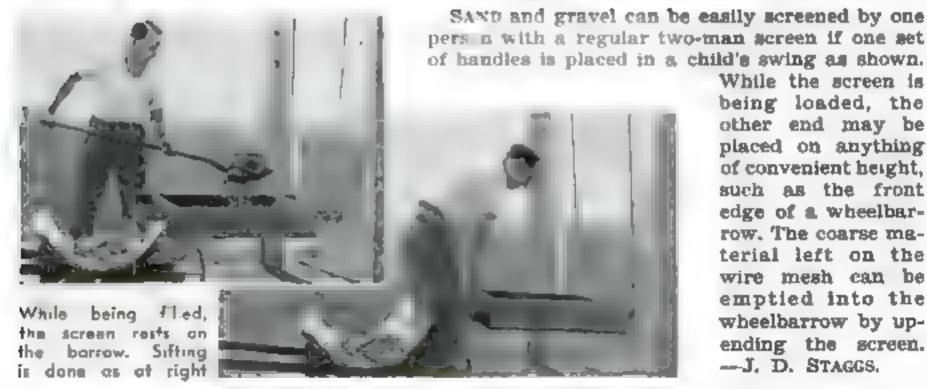
The cross-stick type of boomerang is still easier to make. Rip out two strips 3/16" or ¼ " by 2" by 24". Find the center and glue together into a perfect cross. With the spokeshave, round off the top of each segment, working it thin on the edges but leaving the middle flat. Round off the ends, and bend up to get the dihedral angle from a point about two thirds

A %" dowel, 4 %" long, may be used in the middle, but not glued, as an aid in catching the cross-stick boomerang. Don't attempt to catch the other type.

of the distance from the end to the middle.

The first boomerang described could be made of alternate strips of mahogany and maple to give an inlaid effect, if desired.

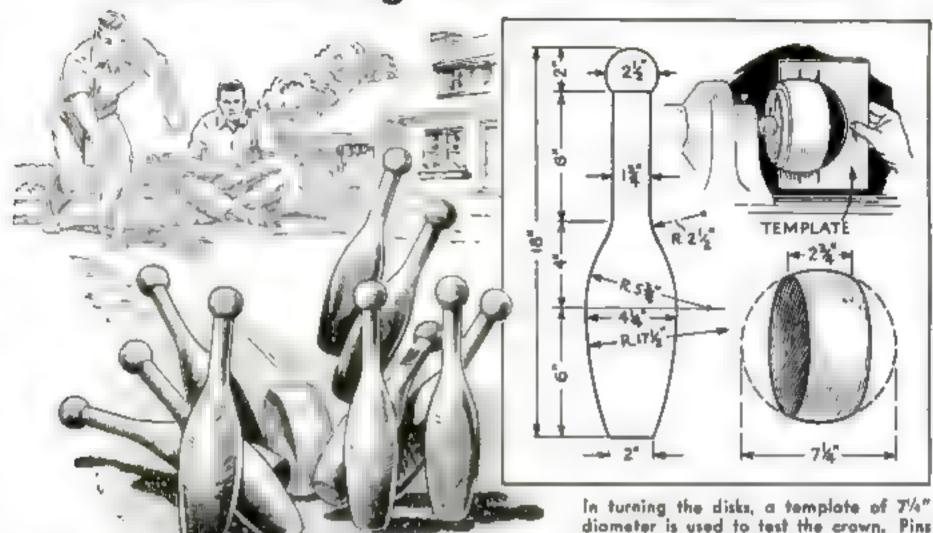
Swing Holds Up End of Heavy Sand-Sifting Screen



While the screen is being loaded, the other end may be placed on anything of convenient height, such as the front edge of a wheelbarrow. The coarse material left on the wire mesh can be emptied into the wheelbarrow by upending the screen.

-J. D. STAGGS.

Lawn Bowling with Wooden Disks



HIS improvised bowling set, which can be made in an evening or two, can be used on either a well-mown lawn or a smooth basement floor. It provides an inexpensive way to enjoy the sport of bowling.

If a number of old Indian clubs can be obtained, they will serve as the pins.

Sometimes discarded clubs can be picked up for little or nothing at a gymnasium. As a rule, however, it will be necessary to turn the pins on a lathe. They can be turned to about the size and shape shown in an accompanying drawing, but the dimensions may be changed, if necessary, to fit the available material. Hardwood is better for the work, but soft may be used.

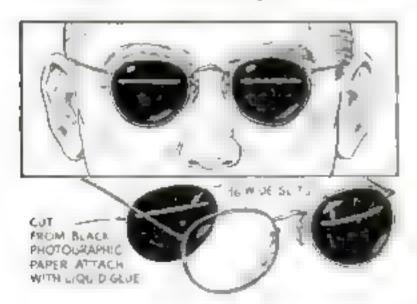


For bowling at home, the disks are an inexpensive substitute for balls

Each "ball" is made from a disk cut from 3" by 8" stock. The edges are turned to form a circular arc just as though each piece represented a part of a real ball. A template should be cut from thin wood to test the accuracy of the turning.

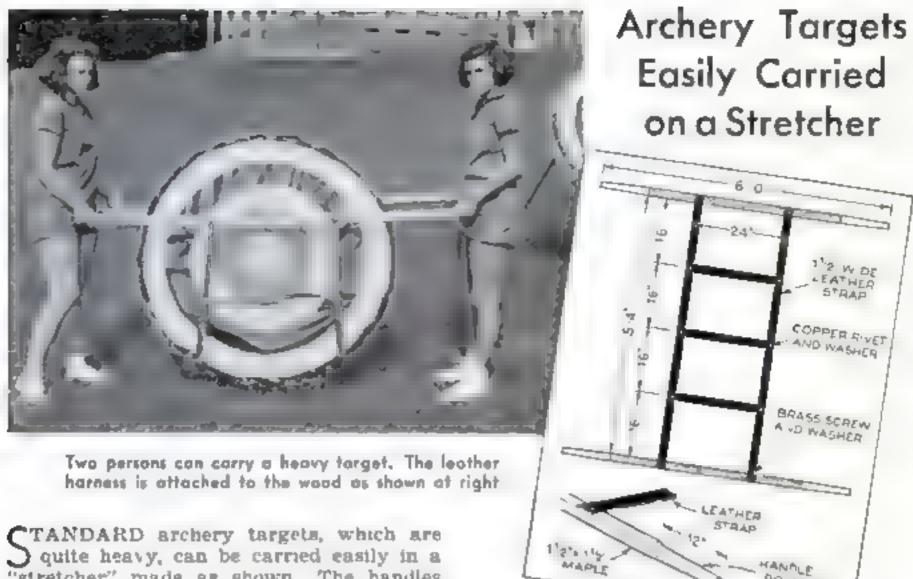
can be turned to about the size given

The bowling may be done with ten pins, or played like the regular game of "bowling on the green."—R. J.



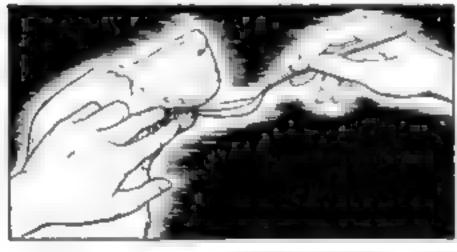
Sunglasses for Emergency Use

THOSE who regularly wear spectacles can convert them into efficient sunglasses when necessary by the method illustrated. This idea has long been employed by the Eskimos to prevent snow blindness. It is an invaluable expedient when one is exposed to brilliant sunlight and eye-searing reflections on a fishing trip, at the beach, or in the snow and has had no opportunity to provide regular sunglasses. The spectacles continue to give the necessary optical correction.—J. E. H.



"stretcher" made as shown. The handles are two pieces of 112" square maple 6 long, the ends of which are shaped round for about 12" so they will not hurt the hands. Two pieces of leather of harness thickness, 67" long and 14," wide, are fastened to the bars with 1" No. 8 roundhead brass screws and washers at points 12" on each side of the center. Three 24" long

pieces of leather of the same thickness are spaced equally apart along the 64" lengths and fastened with flathead copper rivets and washers. Sandpaper and stain the bars, if desired; then give the wood a coat of shellac or varnish,—LESLIE D. WILDING.



Giving Liquid Medicine Safely to a Dog

THE easiest and safest way to give a dog liquid medicine is to pour it either from a spoon or a vial into the corner of the mouth. The dog's head should be held at an angle of about 45 deg., and the first and second finger of the left hand used to part the loose flews at the corner of the mouth. Pour the medicine into the pocket so made. The head then can be gradually tipped back while the jaws are being held shut. This will cause the dog to swallow the medicine naturally.-W. H. Foster.

Knee Bands Repel Briers

HUNTERS, campers, and hikers know how annoying it is when briers catch on the part of the sock that overlaps the top of the boot or get into the boot itself. To prevent this, cut two bands of inner tube 3" or 4" long. clean them thoroughly, and slip one over each boot, pulling it up until half the rubber extends beyond the boot and covers the overlapping sock .- JAMES E. Polisso.

The based of rubber forms a flazible and comfortable





All shapes are cut out with a jig saw, then carved with a hand motor tool, if available. Candleholders, place-card holders, and salt and nut holders are each made in a single piece. The centerpiece has a base representing wave ripples, fastened on with strong liquid glue or, better still, the special cement supplied by the plastic manufacturer. The combination ash tray and match holder is made in two pieces, cemented together as shown. The cigarette holder requires three pieces. Polishing is done as

outlined in previous articles of this series.

Cups to fit the nut and salt holders, and

to form ash trays, are made of pewter. Narrow strips of pewter are first bent to form rings, then the bottom pieces are cut out and soldered onto them with very soft, low-melting solder.

END VIEW

CIGARETTE HOLDER

101 - 1/6

3 PISCES CENTENTED TOGETHER

SIDE

V.EW

TOP

V EW

ASH TRAY

AND MATCH HOLDER

Leather Album Converted into Stationery Box



With a sharp knife, all the pages are cut away so only the back and covers remain



Make a suitable wooden frame and give it to the back and bottom cover of the book



LD-FASHIONED photograph albums or large leather-covered books can be converted into attractive boxes for stationery, candy, trinkets, and the like at practically no cost.

Measure the length, width, and thickness of the leaves only (not the covers). From these dimensions make the four sides of the frame or box from 3/16" soft pine or basewood strips. Have the strip along the back slightly wider than the other sides.

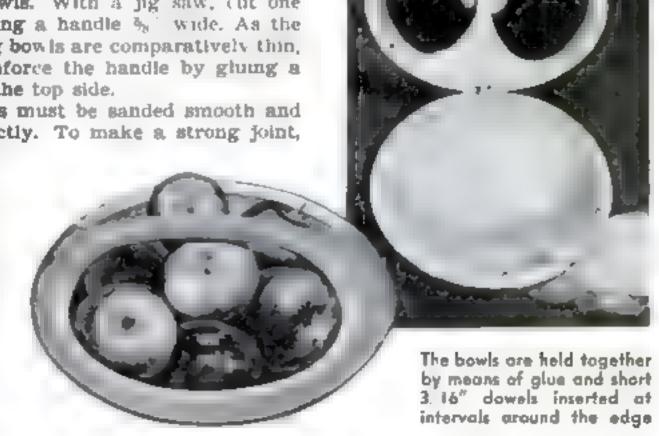
While the glue on the frame is setting, cut all leaves except the flyleaves (if any) away from the covers. Fit the frame into the cover, and glue the back and the lower edges in place. Glue a strip of cloth along the inside edge where the cover hinges on the wood frame. The outside edges of the box are painted with gilt and then given a coat of dull varnish.-J. W. C.

Altered Chopping Bowls Form Attractive Fruit Holder

N ATTRACTIVE fruit bowl may be made from two maple chopping bowls. With a jig saw, cut one bowl out as shown, leaving a handle & wide. As the bottoms of most chopping bowls are comparatively thin, it is a good idea to reënforce the handle by gluing a small strip of maple on the top side.

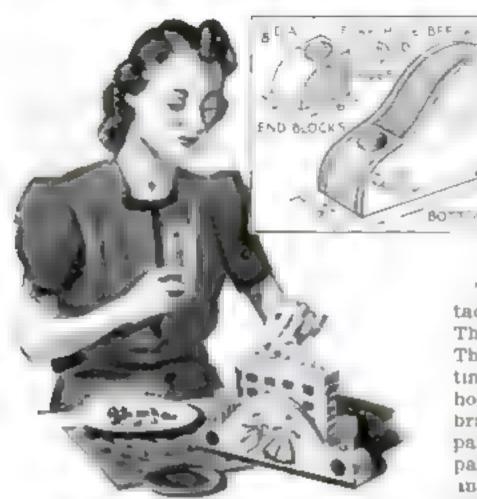
The edges of the bowls must be sanded smooth and flat to fit together perfectly. To make a strong joint,

short 3/16" dowels are inserted and glued in holes drilled at intervals around the edges of both bowls. Rubber bands cut from inner tubes may be used to hold the bowls together while the glue sets. Then remove the bands and give the edges a thorough sanding. Two coats of flat-drying varnish give a soft finish.



RAFTWORK

Colorful Table Novelty Holds Paper Napkins



This gayly painted napkin set lends added color to a refreshment table or tray when snacks and titbits are served. It holds a supply of small, square-folded paper napkins and colored toothpicks for spearing hors d'occurres.

The two plywood sides, 3/16" thick, are tacked together and acroli-sawed at once. The bottom is 4" plywood, 144" by 8". The end blocks are maple. To avoid splitting them, they were first bored with %" holes as shown, then cut off. Assemble with brads, sand with No. 6 garnet paper, and paint any desired color. Transfers or bandpainted decorations can then be added in any style preferred. The holder shown is painted pea green.—BRUCE MACINTOSH.

PLYWOOD

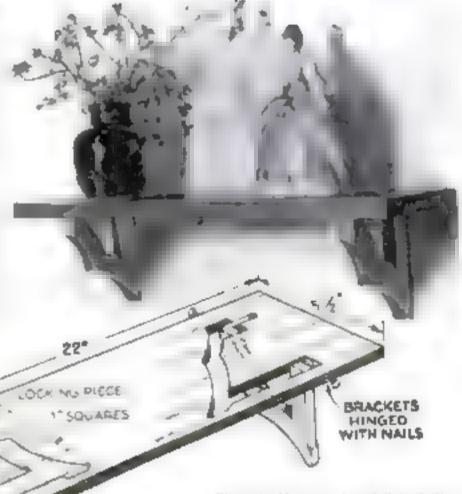
Portable Shelf Contains Its Own Brackets

NE plece of walnut 54" by 22" furnished the material for this portable shelf, which folds flat for shipment or storage. After being jig-sawed as shown, the brackets are hinged with nails. The heads are cut off and the nails driven below the surface so that the holes may be concealed with slivers of walnut, which are glued into place and sanded smooth.

Note that the brackets are designed so that they can be locked in the open position by means of two small locking pieces. All surfaces are sanded to smoothness and then finished with shellac. The shelf is hung on L-shaped screw hooks set firmly into the wall.—Frank Wheelock.

Brackets and shelf are jigsawed from one piece. Note the ingenious lock for hold-

ing the brackets in position



The shelf may be folded flat for shipment or storage. It hangs on two L-shaped hooks

Tiny Parts Cut from Paper

VERY small ship model fittings, such as boom and gaff jaws, and other tiny craft-work parts usually made of wood can be cut from six or seven layers of bond paper glued together with cellulose cement.

Ivy-Pot Bracket of Hammered Copper

ALTHOUGH there are many ways to hang a pot of ivy against the wall, one of the simplest and most ornamental is to make a bracket like the one illustrated. You may, indeed, wish to construct several of them because they are so simple. They can be hung on windows or walls, as preferred. Adapt the dimensions to suit the pot used. In this case it happened to be 3" in diameter at the bottom, 41/2" at the top, and 4" high.

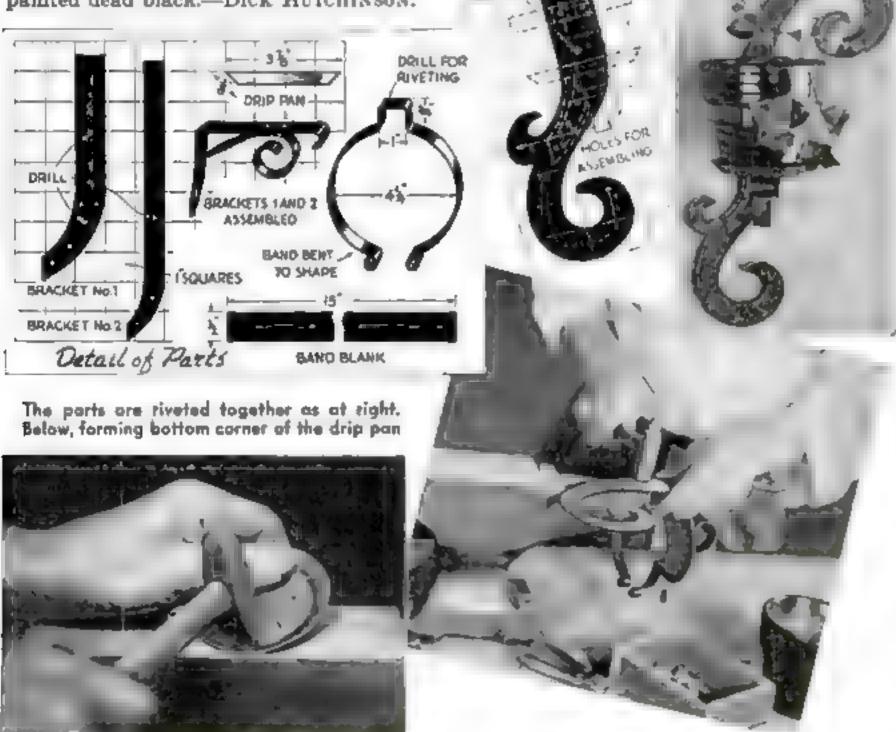
The back plate is outlined on a piece of 14-gauge soft sheet copper, and is cut with the tin shears and a cold chisel, filed smooth, and hammered on the face. The bracket parts and the band are cut from 16-gauge stock, and are hammered and formed as shown in the drawings. The drip pan is a disk of 18-gauge soft sheet copper. It is raised to a depth of about

%"; then the bottom corner is formed.
Assemble all parts with No. 14 brass rivets or escutcheon pins. Swab the surface with a liquid solution of copper nitrate and heat until black. Dust off and repeat until completely black, then wax with floor wax and polish.

Iron may be used in place of copper and painted dead black.—DICK HUTCHINSON.









BROWN AND GREEN COLORS

[METAL WORKING]

The following formula will produce a permanent finish, either brown or black, on copper, brass, bronze, or nickel silver:

Place some commercial nitric acid in a glass jar, and dissolve all of the scrap copper that the acid will consume, thereby producing a liquid copper nitrate. Do not allow this solution to come in contact with the hands or clothing. Using a swab, coat the surface of the piece to be colored with the acid. Apply heat, preferably with a blowtorch, until it turns first green, then brown. Stop the heat the moment the piece is all brown or the color will burn out. Let cool and dust off. If the color is not dark enough, repeat the operation.

About three burnings will be required to produce a good black finish. If the brown finish is used, burnish the high lights on the hammered parts with fine emery paper. Polish the finished work with ordinary floor wax. No lacquer is necessary.

A satisfactory verd-antique or verdigris-green finish may be produced by coating the piece with copper nitrate as above and allowing it to dry in the sun or in a warm room. When thoroughly dry, coat with lacquer. This is excellent for out-of-doors work such as lanterns, hardware, and copper trim.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

New Marble Game Tests Steadiness of Hand

"Mountain Climber" is a fascinating new table game in which marbles are pushed up an incline with the aid of a small, flat stick until they fall into numbered holes. Although the game may look easy, the marbles have a tendency to roll off the side of the stick. A good score therefore calls



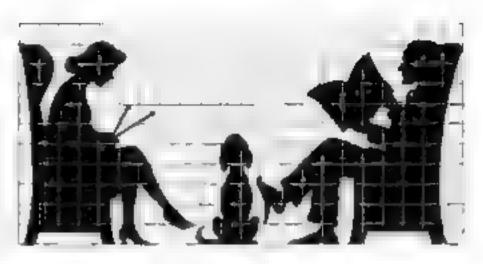
The object of the game is to push marbles up the "mountain" so that each stops in a numbered hole

for steadiness of hand and calm nerves. Considerable practice is required before one can control the marbles.

Each player is given five marbles for the "climb." When all have been used, the ones which have been successfully deposited in holes are counted according to the value of the holes. The highest score wins.

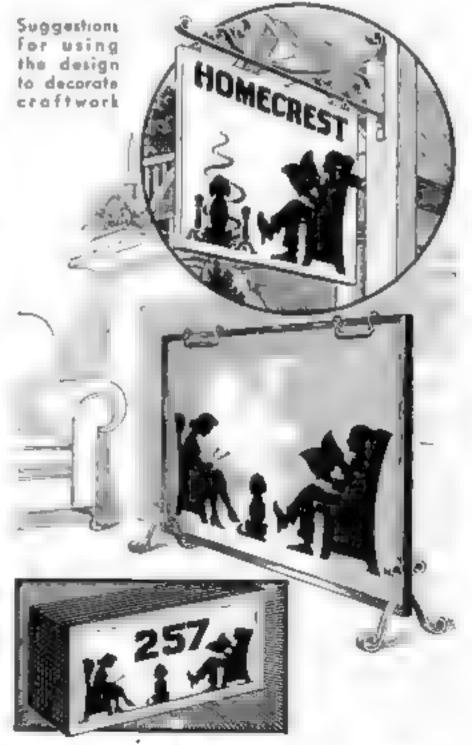
Once a marble drops into a hole it cannot "climb" again. When a marble falls down the mountain it is "lost."

Whether made of heavy cardboard or wood, the incline should have a smooth, flat surface. Paint or wax crayons may be used for the decorations.—MYBON FLEISHMAN.



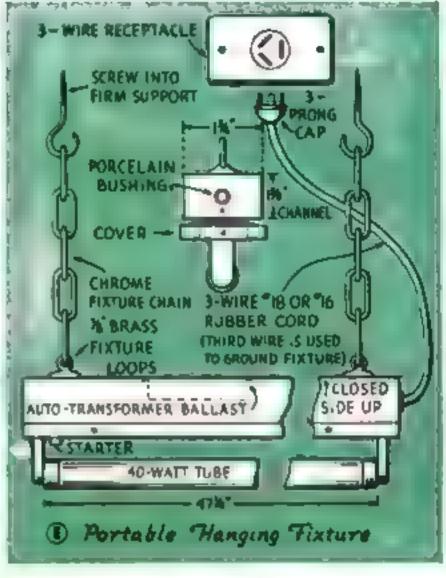
Silhouette of the Month: "Fireside Comfort"

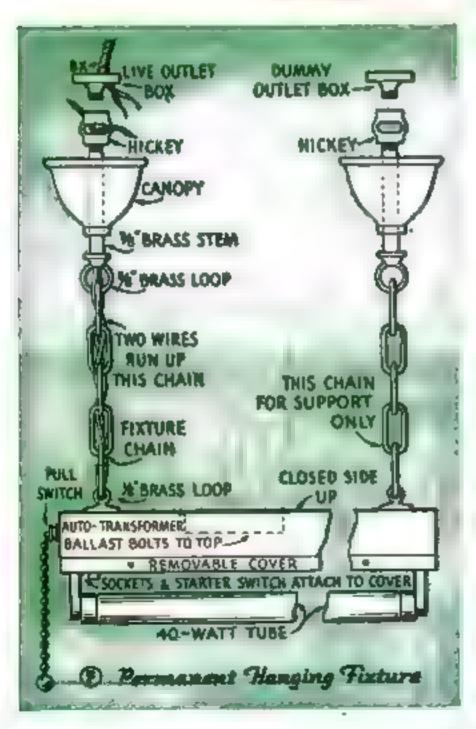
HERE is a silhouette that can be adapted to many purposes. Scroll-sawed from plywood, the figures can be used, for example, as a name board or to ornament an illuminated house number. Cut from sheet metal, they will decorate a fireplace screen. Since they are separate, the figures can be set as far apart as the individual project requires, or they can be used individually. Any degree of enlargement may be obtained by drawing squares of the necessary size and copying the outlines through the squares from point to point.



BUILDING FLUOPESCEMP







THIRD problem in building fluorescent lighting fixtures is where a portable fixture is desired, and the ceiling height is such that the lamp must be suspended on chains. The fixture is made as before (drawing D), but it is suspended by means of two brass loops and chains, as at E. A rubber cord and plug allow connections to be made to a three-wire polarized receptacle.

Reflectors can be easily added to any of these fixtures by bending up the material to the required shaps, as shown in drawing G. Polished aluminum or sheet metal sprayed with white enamel or lacquer gives a satisfactory surface.

In general, 15-watt, 20-watt, and 40-watt tubes are 1½" in diameter and have a comparatively low surface brightness. Because of this, they can be used exposed without reflectors and will give a good spread of light all over a room. On the other hand, the 1" diameter 15- and 30-watt tubes are somewhat brighter and should be used in a re-

One of the main features of the fixtures illustrated is the use of the new separate starter switch. Formerly the switch and reactor were combined in one unit called an auxiliary. If the switch went bad, the whole

flector when possible to protect the eyes.

Lighting Fixitures

PART TWO

By HAROLD P. STRAND

unit had to be replaced
The latest advance in
the industry is a small
starter switch, which is
easily inserted and removed from the bottom
of the fixture. With
this is used a simple
ballast or reactor

If, however, 30- or 40-watt tubes are to be operated, an auto-transformer must be used with the starter switch, and it also serves as the ballast. This is because the longer tubes do not operate directly at the low 115-volt pressure, but must have equipment to step it up to the required voltage

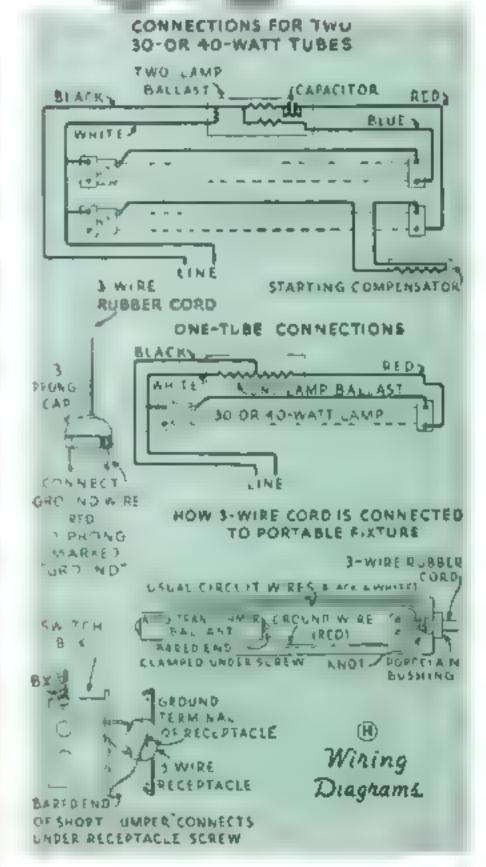
An excellent method of hanging fixtures permanently on chains is shown at F.

When making fixtures using two tubes, a two-lamp ballast unit can be substituted for two ballasts. This contains a capacitor to correct low power factor and flicker, and makes an efficient control unit. However, care must be taken to see that the channel dimensions are sufficient to accommodate the larger unit. When using this type of unit and separate starter switches with the 30- and 40-watt tubes, however, a separate compensator may have to be used in addition. This is placed in the channel with the ballast (drawing H.)

With single-tube fixtures, the low power factor that is characteristic of fluorescent lamps can be corrected by installing small capacitors in the channel. If preferred, however, a larger one can be installed elsewhere to take care of several lamps. For an individual lamp, a capacitor of 4.75 microfarads will bring up a power factor of about 50 percent to nearly 90 percent. A capacitor of 17.5 microfarads can be used for five 30- or 40-watt tubes with a thermal type auxiliary or starter to obtain 90 percent power factor. These devices are connected across the line at or near the ballast.

Fluorescent lamps can also be operated







Fluorescent fixtures are ideal for the laundry room

on direct current with some success. In general, only the 15- and 20-watt sizes can be used because it is not possible to step up 115-volt current to the higher voltage for starting the larger lamps.

The only change necessary for D.C. operation is to connect a resistor in series with the reactor or ballast to limit the current. Care must be used to ventilate the resistor properly because of heating, and connections should be made with wire having heat-resisting insulation. At 120 volts the 15-watt T-8 tube requires a resistor of 198 ohms and the 20-watt T-12 tube a resistor of 144 ohms. For 115 volts, resistors of 180 ohms and 125 ohms respectively would be required. The efficiency is less than with A.C. operation.

The construction described is standard practice, but some localities may have adopted special regulations so ask your electrical inspector if in doubt.

Foil-Lined Lamp Shade Acts as a Reflector

By LINING them with metal foil, metal lamp shades like the conical one shown can be made into efficient reflectors that concentrate the light mainly in one direction. The foil can be fastened by coating the shade surface with spar varnish, enamel, or baking enamel, letting it dry until tacky, and then pressing the lining into contact. It can be smoothed out to make a good specular (mirrorilke) reflector, or crinkled to scatter the reflected light over a wider angle.



FLEXIBLE CORDS TO USE

[ELECTRICAL]

When an electrical appliance requires the replacement of its cord, select the proper type of cord to insure safe operation, as follows.

| Uno | Trade mante | Type | Outer envering |
|---|--------------------------------|----------------------|-------------------|
| Fint Irons, tonsters, wadie irons, grills, room heaters margles used in dry places | Heater cord | HPD | Cotton or enyon |
| Reating the damp places | Rubber jacketed beater cord | Hel | Cutton and rubber |
| lamps small radios. light appliances, ity places | Para lel cord | PO-81 PO-32 PO | Cotton or rayon |
| Lamps, etc., damp or dry places | All tubber Paranel cord | POSJ 32 | Rubber |
| Vacuum cleaners, large radios, drills, refrigerators washing machines, shop motors etc damp or dry places | Justier rubber cord | 製 | Rubber |
| Extra hard usage or heavy duty | Hard service rubber cord | -8 | Rubber |
| Subject to mechanica, injury dry places | Armored reën forced cord | PA | Cotton and metal |

POPULAR SCIENCE MONTHLY SHOP DATA FILE



BX-Conduit Saves Time in Coiling Fish Tape

ONE electrician coils his fish tape through an 18" piece of BX so it can be handled rapidly without kinking. By holding the flexible BX in one hand and revolving the rolled steel fish tape with the other hand, he feeds the tape into the conduit swiftly.

Attaching Wires Quickly

In experimental work, wires can be connected temporarily to sheet metal or screen wire with brass paper fasteners of the type shown. Insert the wire into the fold of the fastener and squeeze shut over the edge of the material. For sheet metal, punch a small hole. Solder for greater permanency.



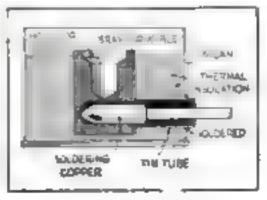
Soldering Copper Heats Miniature Furnace

Radio repairmen, electricians, and others having occasion to tin wires or similar small parts will find the miniature electric furnace illustrated below a great convenience.

The brass crucible is a short piece of brass rod of a diameter slightly greater than the length of the small soldering-copper head. A hole is drilled to receive the copper, and another to form a cavity for the molten solder. The crucible is placed in a housing made by cutting down a tin can, and surrounded with thermal insulation such as glass wool, asbestos, or plaster. A tube, made from a piece of the tin can, connects the lateral hole in the crucible with the outside of the housing. If the insulating material does not hold the parts securely, fasten the crucible with a machine screw through the bottom of the housing.

The soldering copper may require ten or fifteen minutes to heat the crucible to the melting point of solder. The process can be hastened, if necessary, by directing a torch fiame into the furnace from the top. A lid made of asbestos or other suitable material will reduce the escape of heat from the top. To tin wire ends, coat them with flux and dip them into the molten solder. The soldering copper can be removed for several minutes at a time without permitting the solder to solidify. It is best to place a thin layer of insulation under the furnace so the bench top will not be scorched if the metal becomes too hot.—Ervin Walters.





in the furnace shown above, the thermal insulator was sand, which was covered with wood-fiber plaster after the device had been tested

Stopping Action

By R. O. LISSAMAN

HEN you photograph a moving person, animal, or object, the image moves across the surface of the that is, the focal plune of the camera - for the duration of the exposure. For the action to appear completely stopped, the exposure must be brief enough to permit a hi vement of not more than about 0.01" when the finished print is viewed at normal viewing distance. Although an image displacement of 0.01" will be satisfactory for a contact print, a negative that is to be enlarged must show less movement than that For example, if it be desired to enlarge the negative five times, the film should have an image displacement of not more than 0 002" An accompanying table gives the approximate exposure for stopping action of various types. The shutter speeds are

Foot race at angle to camera, First man is Taute Maki, coached by Paave Nurmi



Action directly across the camera, as in this case, requires faster exposure than movement at an angle

1/130 SEC

with Your Camera

the slowest that can safely be used. In each case for action of 20 m.p.h. or faster, three speeds are indicated. The fastest is for use when the movement is across the field of vision from right to left or vice versa. The second is for movement at an angle, and the third or slowest is for movement approaching the camera. The table is based on the average focal length of lenses in popular use, that is, a 2" lens for miniature cameras and a 4" lens for a camera using the so-called "twenty" size film.

For contact prints, a short focallength lens, such as those used in miniature cameras, will show less image displacement with the same action and same exposure than a lens of longer focal length. If enlargements are to be made, remember that the greater the enlargement desired, the shorter the exposure must be Close-up action requires shorter exposure than does distant action.

Although the table gives all the information an amateur is likely to require in learning to make good action shots, there are some photographers who are keenly interested in theo-

Approaching action at a speed of about 35 m.p.h. An exposure of 1/200th second stopped it

ry. For their benefit the following formula is given for working out the exposure necessary to stop action in any individual case.

All measurements must be given in inches.

1. Distance object will move compared



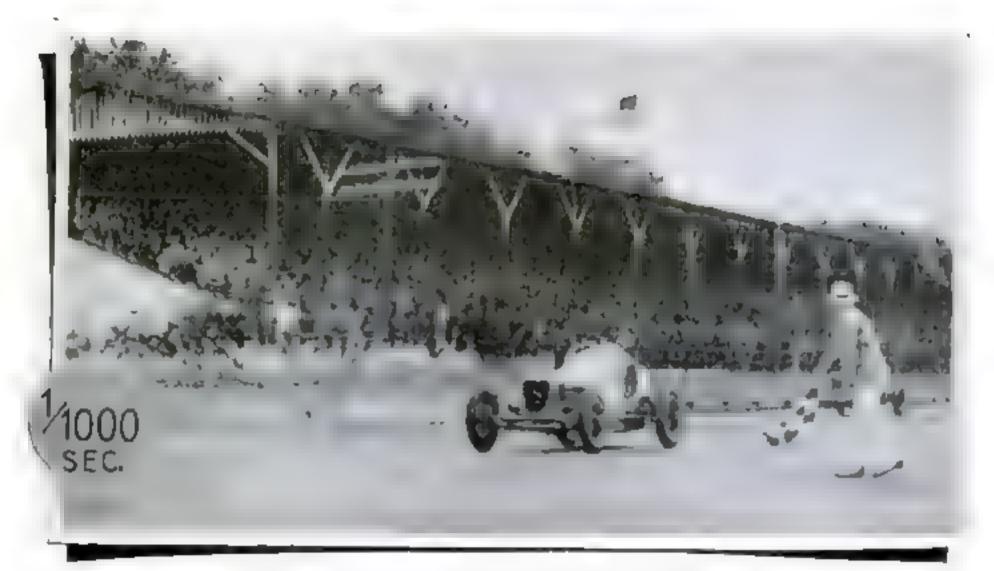
EXPOSURES TO STOP ACTION

[PHOTOGRAPHY]

| Exposure for average miniature camera | | | | | Exposure for average 2 % " by 3 % " camera | | | |
|--|------------|-------|---|----|--|-------|--------------|--|
| 1. | /15 to 1/5 | 50 | Average views, pe- destrians, etc | 5 | 1/25 to 1/100 | | | |
| \leftrightarrow | X | 1 | | | \leftrightarrow | X | \downarrow | |
| 1/100 | 1/65 | 1/40 | Athletic events, foot races boats baseball slow street traffic etc. | 20 | 1/200 | 1/130 | 1/80 | |
| 1/200 | 1/130 | 1/60 | Brisk trame, horse races, motor boats diving, etc | 30 | 1/400 | 1/260 | 1/120 | |
| 1/350 | 1/250 | 1/125 | Highway traffic, birds on wing, planes fast trains, etc | 60 | 1/700 | 1/500 | 1/250 | |

Note: Use the shutter speed closest to the given speeds. For general use speeds slower than 1/50 should not be hand held especially if enurgements are required. The above figures will permit only contact prints or small enlargements to be made. The greater the enlargement desired, the shorter the exposure must be.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



Snapping the finish of an auto race takes real speed, especially if you intend to enlarge the negative

with permissible image movement, which can be stated: Displacement permissible

 $\times \frac{\text{Distance to object}}{\text{Lens focal length}} \text{ or Disp.} \times \frac{\text{D}}{\text{F}}$

2. Distance object will move in 1 second. At 1 mile per hour, 5,280' or 63,360" 63,360

object will move $\frac{63,360}{60}$ or 1,056" in 1 minute

and 1,056 or 17.6" in 1 second

Thus the formula may be stated: Required exposure in seconds=

Disp.
$$\times \frac{D}{F} \div (17.6 \times m.p.h.)$$



Scoop for Small Bottles

A SCOOP for getting into small-necked bottles when weighing photo chemicals may be made from a face-powder scoop of the type shown above. These scoops are designed for filling compacts and usually sell for five cents. All that is necessary is to extend the handle with a section of discarded knitting needle or a small dowel. Example: To photograph a train at 60 m.p.h. at 50' (600") distant with lens of 8" focal length.

$$\frac{1}{100} \times \frac{600}{3} \div \frac{17.6 \times 60}{1} = \frac{1}{100} \times \frac{600}{3} \times \frac{1}{17.6 \times 60} = \frac{1}{528} \text{ second}$$

This gives the exposure when the movement is passing directly across the camera field of view. Action approaching or leaving the camera at 45 deg. may be stopped with one-third longer exposure. Action directly approaching or leaving may be stopped with two-thirds longer exposure.

Roll-Film Tank Corked to Keep Out Dust

AFTER using a roll-film developing tank, it is advisable to plug the opening in the lid with a small cork or a pledget of cotton to keep out dust and chemicals that may be floating in the air.—E. A. B.



WHEN I have to make several prints of a photograph, I borrow the metronome from its place beside the piano. By counting its ticks, I can time the exposures and also the developing period.—FERDINAND G. HUP.



Wet Prints Trimmed Easily with Knife

IF NO trimming board is available, by far the easiest way to trim photo prints, surprising as it may seem, is immediately after they have been washed and while they are still wet.

Place a wet print face up on a smooth board, such as a bread board, a piece of plywood, or a drawing board, and cut it with a very sharp, large pocketknife blade, a hunting knife, or any other stiff-bladed knife. A large drawing triangle makes the best guide because it gives greater safety to the fingers and can be held down better than a ruler.—O. P. SHIER,

Avoiding Finger Marks When Loading Film

FINGER marks on film can cause irreparable damage, especially in warm weather or in a bot, poorly ventilated darkroom, when one's fingers are likely to be quite moist. Such blemishes are easily avoided, however, by using a pair of soft chamois finger cots for the thumb and forefinger. These will absorb moisture and protect the film while a tank or film cartridge is being loaded.

Cut a rectangle of paper 2" by 3" for the forefinger and another 14" by 4" for the thumb. Wrap them around the fingers, mark the approximate size and shape, and use them as patterns for cutting the chamois. Stitch the cots as shown, fitting them so tight they won't slip off. Make a new pair when they begin to get dirty or collect too much lint.—NATHAN SPERSER.





RETOUCHING PRINTS, PART I

[PHOTOGRAPHY]

With Artist's Black Oil Color. First apply a sizing medium to entire surface of print with a wad of cotton. (A good sizing medium consists of 1 oz. turpentine, ½ oz. linseed oil, and from 15 to 20 drops of japan gold size. Shake together well and let stand overnight.) For shading large areas, charge a cotton wad with black oil paint, and rub it on waste paper until the color can be applied lightly and evenly. For smaller areas, use bits of cotton twisted on the end of a toothpick or a paper stump. For lines and spots, use a spotting brush and thin the color with turpentine. Remove undesired or surplus color with the sizing medium. A scrap of glass will serve as a palette.

With Printer's Ink. Obtain half-tone black from a local printer or printing supply house. No sizing medium is required. Use like oil color, but thin with artist's pale drying oil. A soft eraser will remove undesired ink while still wet. This is a versatile medium and leaves such a tough film that glossy prints retouched with it may be referrotyped.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



form, Fig. 1, should be accurately shaped, but need not have a perfect surface.

If your model is to have a deck, it should be fitted to the form and held in place with two small brads or weak glue so that it can be removed aft-

er the hull is dry. When a steam power plant is to be installed, a deck will only be In the way, and it will be more practical to reenforce the hull, after the form is removed, with strips of white pine or mahogany as shown in Fig. 2. The transom may also be made of wood, fitted to the form and glued in place the same as the deck-

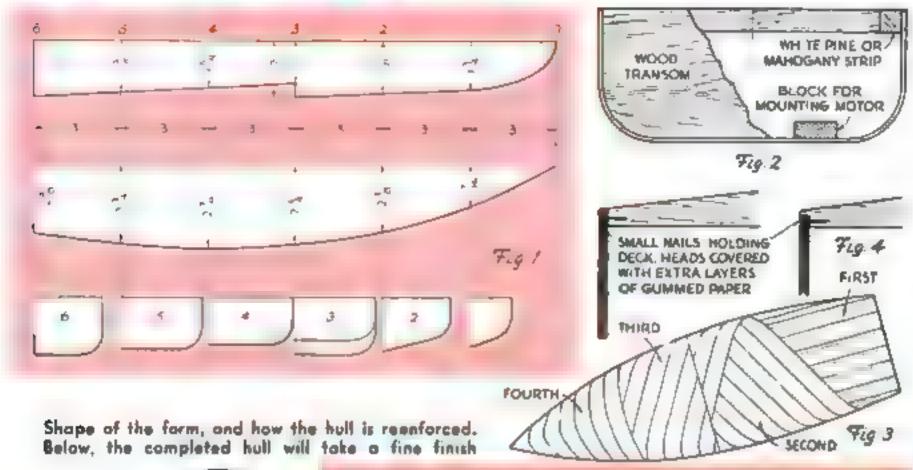
As you may wish to use the form again, it is a good plan to give it a coat of linseed oil or hot paraffin. It is then covered with strips of wet newspaper laid approximately three layers deep. No glue is used

The gummed paper, which goes on next, should not be over 1" wide. Cut off pieces a little longer than the form and, after dip-





FOR MODEL SPEED BOATS





pile up at any one place, shave them down while wet before putting on the next layer. Also add small pieces where needed

so that approximately the same number of layers make up the entire hull. If the hull is 18" long—a good size for your first model—five or six thicknesses of the gummed paper should be sufficient to withstand all ordinary usage.

When the hull is completely dry, it should be smoothed up with sandpaper and given

ping them in water, lay them lengthwise from stem to transom, parallel to the keel. The strips should lap about one quarter of their width. The second layer of paper is put on diagonally over the form, and the third layer at right angles to the first diagonal layer.

Wherever the strips have a tendency to

two or three coats of paint. Sand each down.

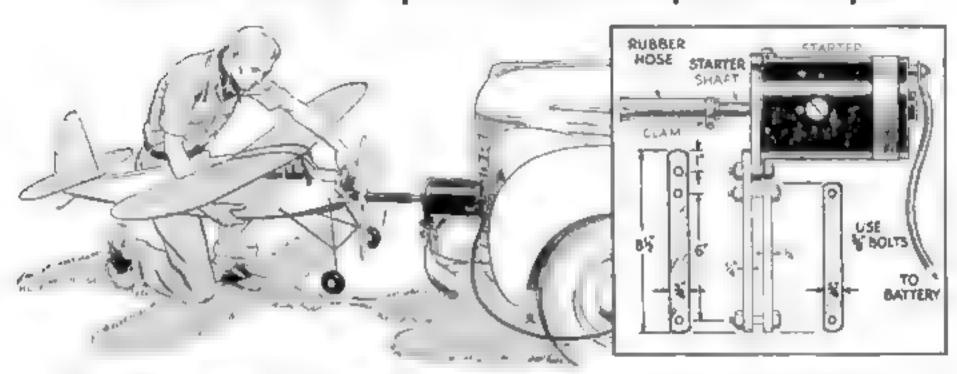
Next, remove the paper hull from the form. Strips of wood are glued to the hull along the edge, blocks are fastened to the bottom to hold the motor, and another block is placed at the "step" to take care of the propeller-shaft tunnel. If you have used a wooden transom, brads should be driven in around the edge to hold it in place. Stick

additional strips of paper over the heads of the brads to cover them, and repaint.

The inside of the hull should be finished with two coats of varnish. Be careful that all corners are covered, because any place left exposed will absorb moisture and ruin the hull.

With this method several duplicate hulis can quickly be made for competitive racing.

Electric Starter Spins Model Airplane Props



THIS electric starter for model airplane gas engines will overcome the starting troubles usually encountered at model-airplane meets.

An old 6-volt auto starter motor is obtained and reconditioned. A piece of garden hose 6" long is securely fastened to the starter shaft with a hose clamp, then split back about 1" at the other end so it will flare out and fit over the nut on the propeller shaft. The starter is clamped

securely as shown to the bumper of an automobile, to which it is grounded, and the cable, which should be heavy enough to carry about fifty amperes, is clipped to the car battery.

The flyer holds his model plane in position with one hand so the propeller hub presses against the hose on the shaft of the starter and then uses the other hand to adjust the gas needle. A plane motor usually starts in a few seconds.—ARTHUR C. STROHM.

Painted Scene Sets Off Miniature Railway Layout

ANY ordinary model-train display can be made more attractive and realistic by a painted background showing scenery. The background illustrated was painted by a professional sign painter on a piece of oilcloth 3' high and 8' long (the length of the layout). Brown, dark green, and tan show-card colors were used in depicting the mountains, and blue in several shades and white completed the sky. While the paint on the mountains was still wet, artificial snow was sprinkled on to give a snow-capped effect. Large travel posters often provide suitable scenes .- C. E. B.



Displays become much more realistic when backgrounds are added





More than 5,000 toys were made by the Long Beach club. At extreme right is Edward Aberal, 84, who painted 1,000 of the toys by hand

THREE Guild Clubs

WIN NATIONAL AWARDS

IN RECOGNITION of their excellent work. POPULAR SCIENCE MONTHLY is awarding large silver plaques to the three home workshop clubs that led the National Homeworkshop Guild during the past season in the fields of civic activities, craftsmanship, and programs for club meetings.

The award for civic activities goes to the Long Beach (Calif.) Homecraftsmen's Club. Its 110 members constructed 5,010 toys for distribution to poor children through the Christmas fund of a local newspaper and 359 additional toys for the Salvation Army, a Mexican mission, and special cases. The club also made shipping boxes for bandages and clothing sent to Finland and Poland, first-aid splint sets for the American Red Cross, game boards for the social room of a church, and envelope

containers for 100 pews in another church. The Timbercraft Homeworkshop Club. New Bedford, Mass., wins the craftsmanship plaque through the efforts of Charles

Saginaw (Mich.) Homecraft Club

Jeglinski, its secretary, who designed and built the nautical chest described elsewhere in this issue. Mr. Jeglinski will receive a special craftwork medal for his work.

FIRST IN CRAFTSMANSHIP Timbercraft Homeworkshop Club, New Bedford, Moss.

FIRST IN CLUB PROGRAMS Portland (Ore) Homeworkshop Club

HONORABLE MENTION CIVIC ACTIVITIES-Ashlobula (Ohio) Homecraft Club, Columbus (Ohio) Homecraft Club,

CRAFTSMANSHIP-Bison Homeworkshop Guild,

In the program division of the contest, the Portland (Ore.) Homeworkshop Club carries off first honors. That club was the subject of a recent feature article (PSM., June '40, p. 164). By means of its high standard of programs and an extensive publicity campaign, it has built up a large and active membership.

The Saginaw Homecraft Club presented its entry in the form of a beautiful album, having veneer pages on which were photos and a description of the project



SEPTEMBER, 1940



Below, inserting a film in the viewer Left, by turning on the flash light the image is compared with the actual object. The designer of the device is a distinguished amateur astronomer

Film Viewer Identifies

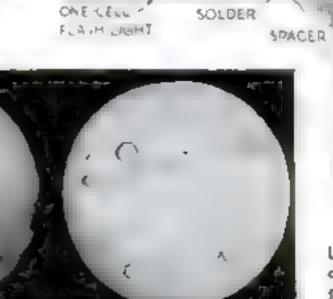
Celestial Objects

By L. C. PELTIER

MERS
toth professional
and amateur, find
it very difficult to
point out to others
some particular
object in the heavens, especially
through the telescope. The simple
little device shown,

however, will unerringly point out a special star in a field full of stars of similar appearance

It consists of a metal film holder to one side of which is soldered a tube for holding a magnifier or eyepiece, and to the opposite side is soldered a small flash light. A flashlight clamp such as is used on automobile steering posts holds the device on the telescope tube so that the observer can see



SHITCH

LAMP SOCKET



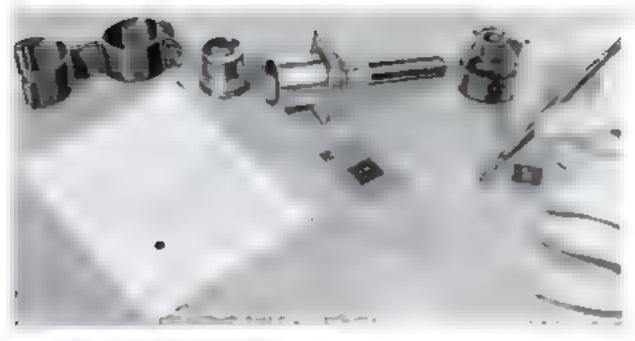
HOLDER

TUBE

Left, object and chart should appear alike in size

through both telescope and viewer at the same time. A greatly reduced photograph is made of a chart or sketch of each region or object to be identified. This negative is placed in the holder, and the object seen in the telescope is compared directly with its corresponding film image seen by transmitted light from the flash light.

Owing to the great reduction, it is usually possible to make two or three transparencies



In making the photographic copy, practically any type of camera and film can be used. Each chart is numbered for easy identification

on one negative and then divide and trim them to size after development. It is, of course, best to make the copies to a scale which will correspond approximately with the telescopic view. For example, if the telescope shows the entire moon in one field of view. the transparency, when viewed through the magnifier, should show a moon of similar size. Standard astronomical charts can be photographed or you can draw your own.

Neon Lamp Tests Circuits in Home Laboratory

AN ORDINARY neon glow lamp is a very versatile test lamp for the home laboratory or shop. Used as shown, it will indicate which terminals are live, approximately what voltage is present, its frequency, and if D. C., its polarity.

The bulb is a 2-watt, 115-volt neon lamp coating 45 cents. It has been acrewed into a 10-cent pigtail socket after the ends of the wires were stripped and tinned. In constant use for over three years on all voltages and frequencies, it has saved many hours of guessing, circuit tracing, and unnecessary shock.

Unlike an incandescent lamp, the neon bulb may be used on voltages ranging from 70 to 550 volts without damaging the bulb, and it will light through resistances as high as 750,000 ohms for continuity testing. The approximate voltage present may be de-

terminated by the intensity and color of the neon glow, once you have noted the appearance of the glow under specific conditions. The frequency is shown by the way the plates light up. Sixty-cycle current shows as a steady glow on both plates, 25-cycle current has a very noticeable flicker, and on D. C. only the plate connected to the positive side of the line tested will become illuminated. -R. B. STETSON.





No Fooling—Oily Rags Are Really Dangerous

EVERY home worker has been told many times not to leave oil- or paint-soaked rags around his shop or laboratory, but it is difficult to understand how great the danger is until a fire actually starts, and then it may be too late. The accompanying photograph, taken by a contributor to this department, shows the burnt remains of an apron used by a high-school student. He had been finishing a project on the lathe by rubbing it with linseed oil, and unthinkingly rolled up the oil-soaked rag in his apron and placed them in his deak drawer. The building custodian found the smoldering apron four hours later and extinguished the fire.





HOW TO PREPARE BACTERIA SLIDES

(here, sour milk) on clean glass with the aid of a platinum loop

2 glass for a second at a time three times in an alcohol or gas flame

STUDYING BACTERIA

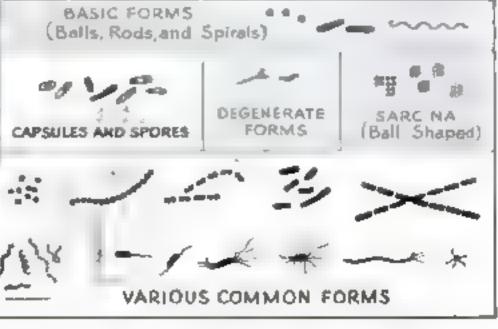
Principal types of bacteria you will see under your microscope are shown in the diagram at right. The sooner you memorize them, the more fun you'll have

By MORTON C. WALLING

BACTERIA, the tiny plants that are the smallest and yet one of the most important of all living organisms, provide a fascinating and adventurous subject for the amateur microscopist. Of the many different types, some are vital to our existence, while others are destroyers of human and other animal life. But all are interesting for microscopic study.

Where can you find a supply of bacteria for examination? The closest source is your own mouth, for if you touch your tongue to a microscope slide, or scrape your teeth with a toothpick, you'll have a ready supply of microörganisms for examination under your lens. Bacteria may also be obtained from raw milk, buttermilk, finger-nail dirt, decayed matter, chicken livers, and a hundred other sources.

The organisms are so tiny, however, that









3 Dissolve fat away with xylol, then drop dye solution on the specimen. Heating speeds up dyeing

After staining, rinse the gloss in water to remove the excess dye

If microscope shows it overstained, add a little alcohol and quickly rinse with water

with Your MICROSCOPE

they must be specially treated to make them more visible under your lens. This is accomplished by the process of staining. The first step, however, is to kill and fix the organisms.

One of the simplest and most widely used methods of fixing is to spread the bacteria-containing material, to which water may be added if necessary, in a thin film on a clean microscope slide or cover glass. Let it dry. Then grasp the glass with tweezers and pass it, bacteria side up, through the flame of a bunsen burner or alcohol lamp three times, taking about one second for each passage. All bacteria will then be killed and fixed, and you are ready for the next step, staining.

There are many stains suitable for bacteria, some of a general type to make any bacterium easy to see, and others of a selective type to color some bacteria and not others, thus helping the microscopist to tell one from the other. At first you probably will find it sufficient to use a single, easily handled stain such as Loeffler's methylene blue.

To make this, mix thirty cubic centimeters of a saturated solution of methylene blue in ethyl alcohol, with 100 cubic centimeters of water to which two drops of ten-percent potassium hydroxide solution have been added. Now lay the slide or cover glass on a level surface and drop enough stain on it to cover the bacteria material. Let the stain act for from three to five minutes, and then rinse in clean water.

Often a dye will stain bacteria better if

COCCI
BALL-SHAPED
BACTERIA
PROM HUMAN
MOUTH

SARCINA,
POUND IN AIR,
ARRANGE THEMSELVES IN CUBES

the glass is heated enough to make the dys solution steam, but not boil, as it is dropped on.

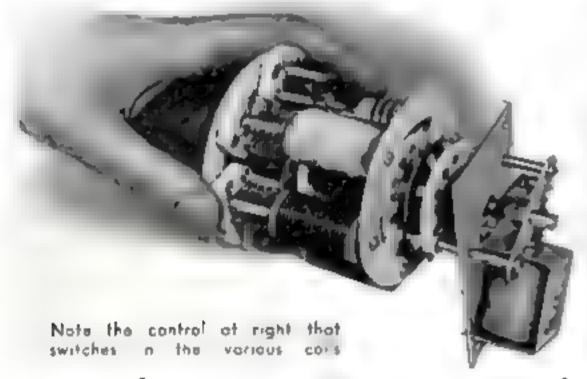
Having stained the bacteria specimen, you are ready to apply a cover glass, if your specimen is on a slide, or slide if on a cover glass. For permanent mounting, use neutral Canada balsam, readily available specially prepared for slide making Place a drop of the balsam on the stained film and lower a thin cover glass in place on top of it.

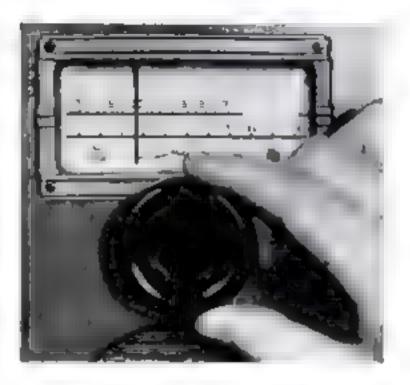
In examining your slides under the microscope, refer to the drawings on this page
or to a book on bacteriology to help you
spot the distinctive shapes and arrangements of bacteria that reveal their identity.

Latest Aids for

Push-Button Switch Controls New Five-Coil Wave Unit

Controlled by an electric push button mounted at any convenient spot on the transmitter panel, a compact set of five coils covering 10, 20, 40, 80, and 160-meter bands instantly switches over to any one of the bands when the push button is pressed. The time and trouble-saving device, shown in the illustration below, shifts bands through a magnetic or solenoid coil mounted on the assembly itself. The tuning coils are set radially around the unit, and each has its own midget 85-mmfd, tuning condenser which is pretuned for complete band switching.



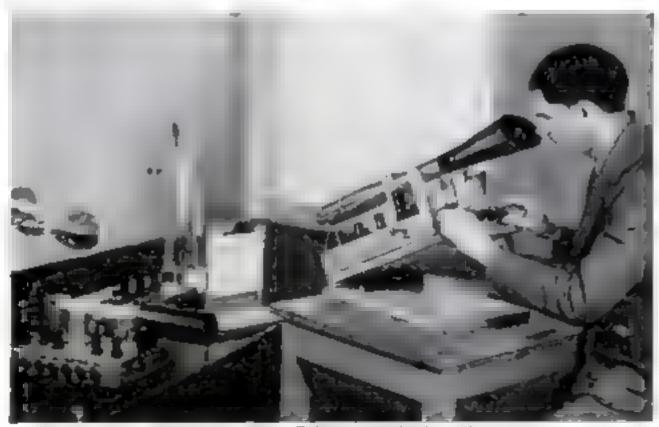


New Weighted Knob Simplifies Tuning

CALLED an inertia tuner, the knob shown above attached to the tuning shaft of a receiver is made of heavy metal and is two inches in diameter. Because of its weight and size, it continues to spin when given a twirl, thus reducing the amount of manual knob twisting necessary to swing between widely spaced wave lengths. The knob has a \(\frac{1}{2} \) hole to fit most tuning shafts. On either the main tuning or band-spread shaft, it gives a smoother touch to tuning.

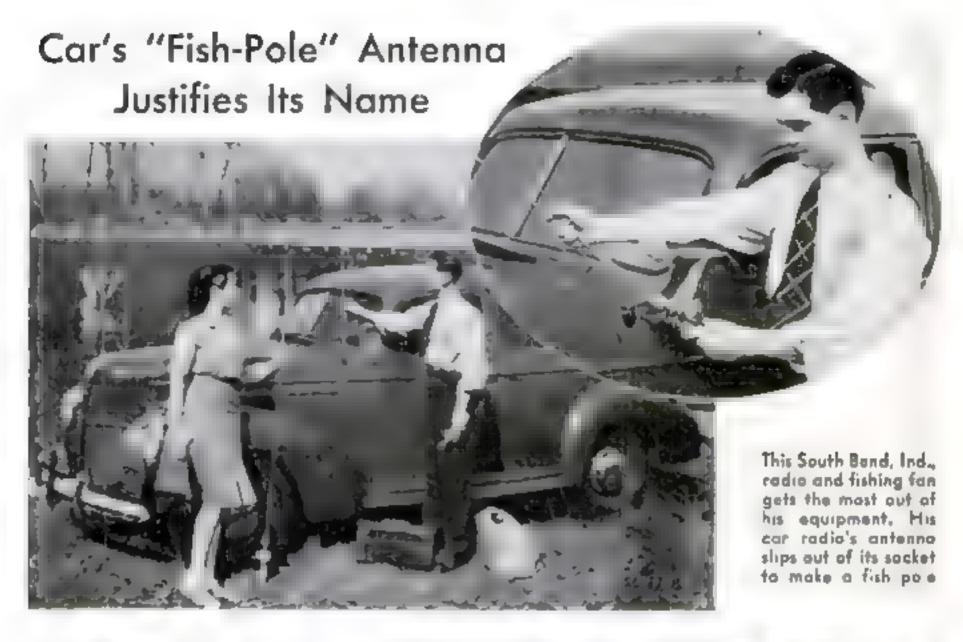
Television Camera Tube for Amateurs

Rabio amateurs who would like to experiment with television transmission as well as reception can now do so with a new inexpensive television-camera "eye" tube just placed on the market. new tube is capable of transmitting a televiaion picture 1 1/4 " square composed of 120 lines. According to the law, anyone holding a radio amateur's license can operate an amateur television transmitter on the 21/4 - meter and shorter bands.



An amateur telecosting his call letters with the television transmitter

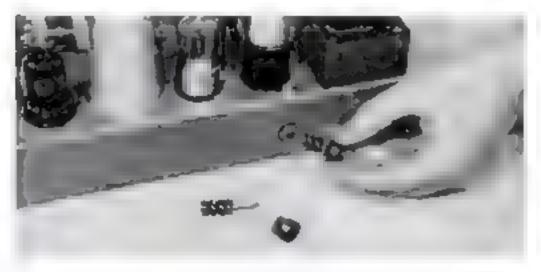
Radio Enthusiasts



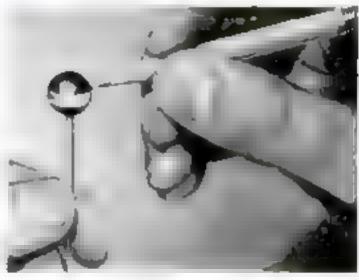
THE "fish-pole" antenna on the cowl of a South Bend, Ind., radio fan's car actually is a fishing pole. Finding it gave him good reception, he fitted a regular steel fishing pole in the antenna socket. Now, when he arrives at a stream, he removes the pole from the car, inserts it in its regular rod butt, and is ready to fish.

Spiral Jack-Cleaning Brush

DESIGNED for cleaning dust or corrosion from the insides of radio jacks, a small spiral brush that fits the chuck of an ordinary hand drill is now available. Inserted in the jack and revolved, it quickly wipes all surfaces clean.



One of these tiny brushes will clean out a jack in a jiffy



Static Muffler for Automobile Radio

STATIC electricity that ordinarily collects at the tip of pole antennas on automobiles, discharging with a violent crackling sound in the receiver, is said to be discharged gradually by the new antenna tip illustrated above. The static "muffler" consists of a small plastic ball girdled by a metal ring around its center. The metal ring, by allowing any static charge to leak off slowly, eliminates most of the annoying discharge noises.

Get Started in



Any good radio-supply store has the parts listed at the right. With them, you can build this circuit, and five more to be described in the next five issues

By ARTHUR C. MILLER

F YOU have always wanted to experiment with radio, here's your chance. With the parts listed at the right, costing about \$8.95, you can build six modern radio circuits—six different radio book-ups specially designed not only to use the same parts but to provide a good course in general radio construction and theory.

The first circuit, described in this article, is a simple two-tube all-electric earphone receiver. Next month, information on a three-tube all-electric earphone set will be given, and in succeeding months a four-tube speaker receiver, a three-tube phonograph amplifier, a three-tube tuned radio-frequency circuit, and a four-tube tuned radio-frequency receiver will be described. After purchasing the parts listed, together with the necessary connecting wire, fuse clips,

WITH A FEW
INEXPENSIVE PARTS
YOU CAN BUILD SIX
CIRCUITS DESIGNED
TO TEACH THE TRICKS
OF SET BUILDING
AND REPAIR

WHAT TO BUY

| Line-card, 135 or 160 ohm | .29 |
|---|------|
| Filter choke, 20 h., 500 ahm | .29 |
| Coils, plug-in, 100-570 meters | |
| [2] | .85 |
| Voriable condenser, .00014 | |
| mfd. | .55 |
| Mica condensers (2), .002 | |
| mfd | .42 |
| Mica condenser, .0002 mfd . | .15 |
| Mica condenser, .0005 mfd. , | ,15 |
| Dual electrolytic condenser, | |
| 16-16 mfd., 250 v. | .97 |
| Shielded paper by-pass con- | |
| denser, .l mfd., 200 v. | -13 |
| Tubular paper condenser, | |
| .006 mfd., 600 v. | .07 |
| Electrolytic condenser, 10 | |
| mfd., 25 v | .24 |
| Pentode-triode tube, 2588GT | .75 |
| Pentode - rectifier tube, | |
| 70L7GT | .75 |
| | |
| I meg. | .40 |
| Carbon resistor, 1/2 watt, | |
| 200,000 ohm | .10 |
| Carbon resistor, 1/2 watt, | |
| 150,000 ohm | .10 |
| Carbon resistor, 1/2 watt, 600 | |
| Warrant and the account of the | -10 |
| Variable resistor, 25,000 ohm | .28 |
| Variable resistor, 250,000 | 0.0 |
| ohms | .28 |
| Six-inch magnetic speaker Four-inch dial | .88 |
| | .26 |
| Octal molded sockets (2) | .18 |
| Six-prong molded socket Rotary S.P.S.T. switch | - |
| R. F. choke, 2.5 mh. | .16 |
| | |
| \$ | 8.95 |

TWO-TUBE ELECTRIC . THREE-TUBE ELECTRIC . FOUR-TUBE ELECTRIC

Radio for \$8.95



A few of the items you need. At right assembling a two-tube all-electric broadcast-receiving set, the first in a series of six

metal panel, wood baseboard, and solder, you will have nothing more to buy.

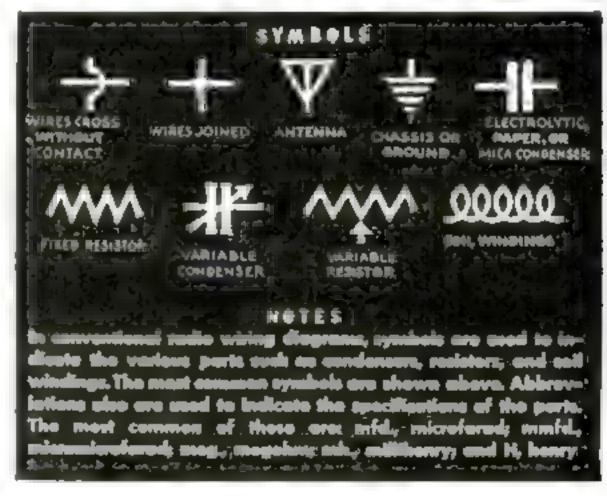
Two tubes of the latest dual-purpose design provide all the tube elements needed in any one of the six circuits. The 25B8GT provides a high-frequency pentode and a high-amplification triode. The 70L7GT provides a half-wave rectifier and an output pentode Both tubes have octal bases with eight pins or prongs.

Before going on to the construction of the first receiver, it will be well to review a few pointers on radio construction in gen-

eral: First of all, use only high-grade parts and make sure that they match the specifications. Second, don't manhandle the parts—remember they have to last for six different circuits. Third, always keep your soldering fron clean and use a solder with a resin core.

The first receiver in this series of six is a two-tube outfit designed to operate on either alternating or direct current of 110 or 115 volts. For these voltages a line cord hav-





ing a built-in resistance of 135 ohms is used and is the right value for all six circuits. If the line voltage in your home is 120 volts, a 160-ohm line cord must be used.

In this circuit, the pentode section of the 25B8GT is used as a regenerative detector (the triode is not used) while half-wave rectifier in the 70L7GT supplies the rectified current for the receiver. (See next page.)

♦ PHONO AMPLIFIER ♦ THREE-TUBE TRF ♦ FOUR-TUBE TRF ♦

Three holes drilled in the metal panel receive the 25,000-ohm variable resistor (used for controlling the regeneration), the .00014-mfd, tuning condenser, and the rotarytype switch. All other parts, with the exception of the .0005-mfd, fixed mica condenser (shown mounted above the tuning condenser), are placed on the wooden baseboard.

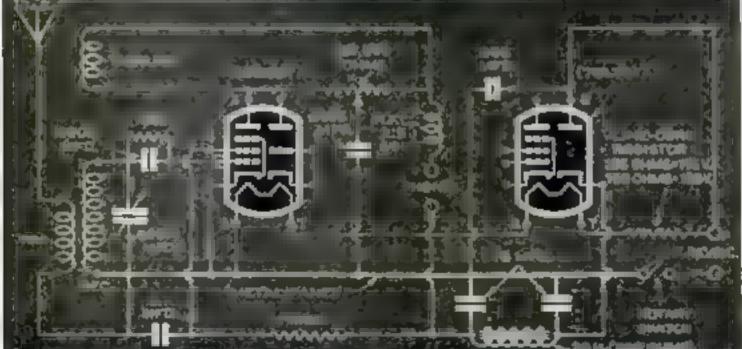
As all the parts will be used over and over again, take care in mounting the resistors and condensers. Also, when buying the parts remember that fixed resistors and condensers with "pigtails" cannot be used.

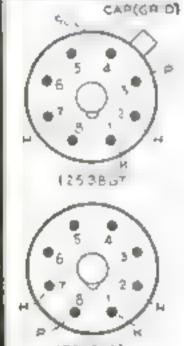
The electrolytic condensers can have flexible leads since they can be mounted in the same place in each circuit, but the re-

sistors should be mounted in clips, like those used

As this is an A C.-D.C. receiver, no ground is needed, the circuit being grounded through the house lighting system. Any type of antenna up to 80' in length can be used. For the reception of local stations an indoor antenna approximately 25 long will be found suificient. It is not advisable to use a long antenna for receiving short-wave signals







SOCKETS (TOP V EW)

Pocket Receiver

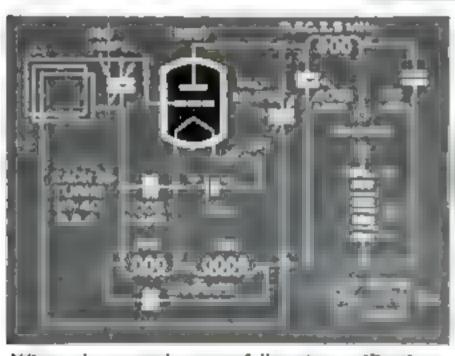
FOR SPORTS FANS

LITTLE larger than a tobacco tin, the pocket receiver pictured below is ideal for sports fans who want to hear the play-by-play broadcasts while watching a game or meet from the stands. The set employs a super-regenerative circuit, using a 958 tube that operates successfully on very low plate voltage. Around the eigar-box-wood case, a loop antenna is wound, consisting of thirty-five turns each side of center, with both sections wound in the same direction. Use No. 40 D.S.C. wire. The two 140-mmf. variable condensers, of the air-padder type, should be mounted with screws before the loop is wound. A brass bushing 14" in diameter and %" long is soldered to the stub

BATTERY BATTERY

shaft of each condenser. A medium-size flash-light cell serves as an "A" battery, while the "B" is composed of four "fountain-pen" cells in series. The latter should last almost indefinitely as the drain is very small, Although the set is decidedly not a distance getter, since it has limited voltage and only a tiny directional loop, it should give good results up to fifty miles on the bands between 650 and 1260 kc.

You can stow this midget receiver in a coat packet. Note the parts orrangement at the right. Cigarbox wood forms the cabinet, and a loop antenna is wrapped around it, while flash-light cells to power the set are carried in the base



Wiring diagram also gives full parts specifications

Taper Wood Screws Keep Crutch Sockets Tight

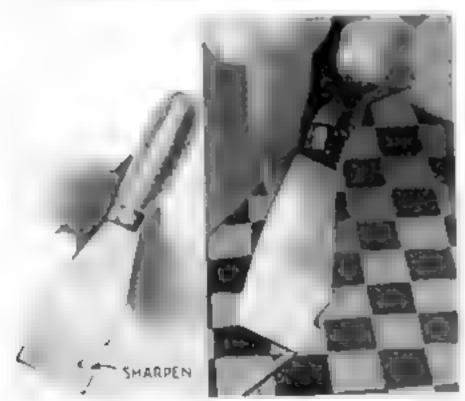
ANYONE who uses crutches with sockets of the type shown knows how annoying it is when the wood shrinks and the loose sockets clank at every step. To cure this, I bought a couple of taper wood screws, removed the sockets from each crutch, and drilled a hole in the end of the wood a little



deeper than the length of the screws and a trifle larger than their small ends. sawed two sits at right angles through the holes and as deep as the holes. I removed the part of the socket holding the rubber tip and placed the sleeve over the end of the crutch. A turn of the screw spreads the split end and holds the alcove firmly.-A. J. PICOLET.

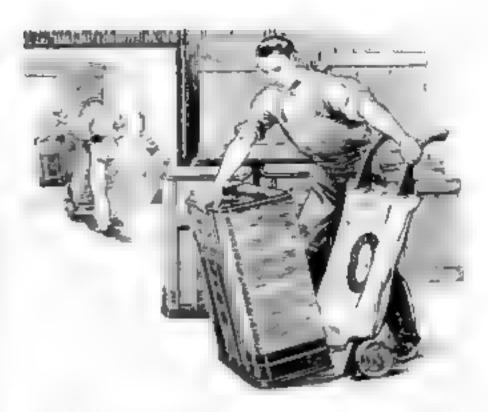


A LINGLEUM cutter can be made by cutting a notch near the end of a first-class putty knife. One edge of this notch is sharpened, and the knife is used as shown below. It has several advantages over an ordinary knife. Circles, squares, and other shapes can be cut as well as atraight lines after you have had a little experience in manipulating the cutter.—WAYNE R. PIERCE.



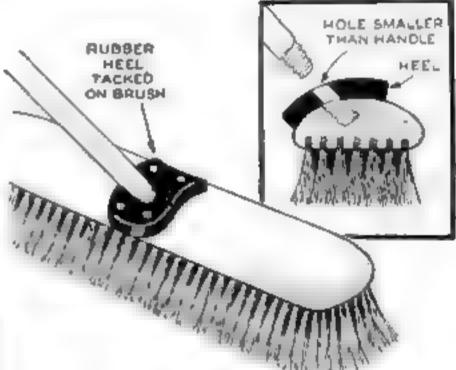
The altered putty knife and method of using it.

A sharp edge is necessary to cut a clean line



Heavy Burlap Sack Pads Edges of Hand Truck

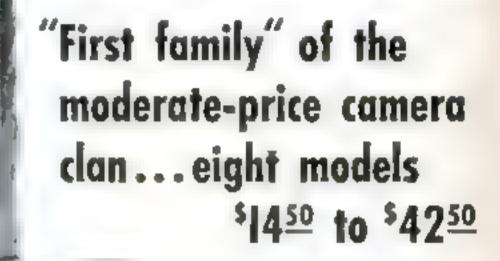
WHEN a hand truck of the two-wheel variety must be employed to move furniture, baggage, or any easily scratched merchandise about a warehouse, cut two holes in the bottom of a heavy burlap sack and slip this over the truck as illustrated.



Rubber Heel Stops Brush Handle from Unscrewing

A school fanitor, who was inconvenienced because the handle of his horsehair floor brush often loosened and parted company with the brush, cured the trouble without the use of nails or screws by the simple method shown above. He tacked an ordinary rubber heel on the brush after cutting a hole through it somewhat smaller than the screw bole in the wood block. Forced into place through the rubber, the handle is firmly held by friction, no matter how long or vigorously the brush is wielded.

KODAK VIGILANTS



inches with the Six-16's, 2'4 x 3'd inches with the Six-16's, 2'4 x 3'd inches with the Six-20's. FEA-TI RES ARF MODIRN... Single push button for opening and closing. Waist-level and eye-level view finders. Retracting body shutter release. Extra-rigid lens support. LENSES are genuine Kodak Anastigmats. And the SHUTTERS, all highly accurate and reliable, include Eastman's new nine-speed Supermatic

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Your Willard dealer has a new Starting Service instrument that "X-rays" the entire starting system of your car—locates hidden "leaks" and flaws before they cause trouble. A Willard Starting Service check-up takes only a few minutes and will save you many a dollar—try it!

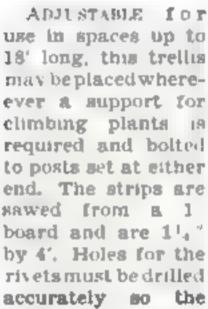
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compactly for storage.

trellis will fold up compactly for storage. Finished with two coats of good white paint, the trellis will last for many years.—B. N.

Toothbrushes Converted into Tool Handles

WHEN the wooden handle of my draftsman's erasing knife split for the second time, I replaced it with a brilliant, clear, red-celluloid toothbrush handle. It took but a few moments to saw off the brush and drill a hole in the cut end to fit the tang of the knife snugly. A little celluloid dissolved in acetone was dropped into the hole, and the tang pressed firmly in. The idea was so successful that I have applied it to all the watchmaker's files on my bench. For larger tools, two handles may be faced off and cemented together with the acetone cement. Marks can be removed with a file and scraper. A beautiful polish may be obtained with a buffing wheel loaded with crocus or jeweler's rouge,-R. B. R.

New improved Willards give you Extra advantages at NO extra cost!



LONGER LIFE

Former Willards were noted for power and long life, but these new Willards are still better. This year, Willard engineers have outdone themselves with a new, greatly improved line of batteries that give 10 to 15% longer average life than former Willards—and at no extra cost.

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permanently molded the
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in the case of each new Willard
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Wiring—With "Safety-Fill," your Willard battery never drinks too much. It's very simple. Very effective. This exclusive new device prevents overfilling—definitely protects your automobile against corroded cables and terminals that cause current

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TOMORROW'S DRIVING

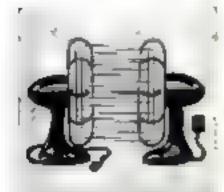
"Alwid" Driving."



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Drive the new and thrilling way . . . the Fluid Drive way. It's all fun and no work! You just touch the throttle to go... touch the brake to stop! Fluid Drive is the drive of tomorrow, but you can enjoy it in a Chrysler now, Try it ... see your Chrysler dealer today.

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SIMPLE AS THIS?

Air from a running fan will set an idle fan in motion, as a breeze turns a windmill. That's the principle of Fiuid Drive.



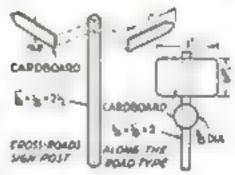
SMOOTH AS DILL

One fan-like wheel drives another by forcing a current of oil against it. Smooth as oil, because it it oil. No rigid metal connections. Can't jerk.

be modern BUY CHRYSLER!



Two Authentic Signposts for Model Railways



ACTUAL aigns were copied in making these model - railway accessories. The lettering is either applied directly to the signs, or first drawn much

larger on a sheet of paper and then copied with a camera. For those not adept at hand lettering, the second method has the advantage of minimizing any flaws.

Locate the crossroads signposts where roads intersect each other, and the along-the-road type between road intersections. Holes drilled in the platform or small tin squares nailed to the bottom of the posts will keep the signs upright. Both the signs shown in the drawings are scaled for "O" gauge.—C. Elmer Black.

Turning Wooden Rosettes

ROSETTES may be turned quickly on the lathe if a smooth board is first attached to the faceplate with a small brad projecting from it in place of a center screw. Start the lathe and hold a lump of rosin against the board over the surface to be covered by the rosettes. The friction will melt the rosin. Then hold the turning stock lightly in one hand, set it on the brad, and with the other hand press it down against the faceplate firmly but slowly. In an instant the rosin will melt between the surfaces and the rosette will stick. After the rosette has been turned, tap it with the handle of a chisel and it will drop off. Stick on another piece of stock and repeat the process without stopping the lathe.-J. J. EDWARDS.

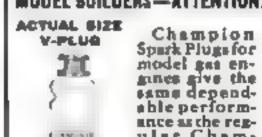


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IN CITIES AND TOWNS all over the United States, the familiar Railway Express truck is a symbol of dependable, speedy, safe delivery. Over 12,000 of these trucks are constantly on the go regardless of weather. Dependability is the watchword.

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Only Champion Spark Plugs have the Sillment seal which keeps them permanently free from trouble-some leakage, common to ordinary spark plugs. Since only one "leaker" in a set will cause rough, uneven, wasteful engine operation, it is obvious that Champion's leak-proof qualities are necessary to maximum performance and economy. Profit by the experience of the nation's largest and most efficient fleets—of the world's racing champions on land, water and in the air—by insisting on Champions for your car.





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same dependshie performance as the regular Champions. Sillment
sealed. Sillimanite insulator, Alloy
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| | V | V-2 | V-3 |
|---------------|-------|--------|---------|
| Hat | 141 | 76_ | %e* |
| Thread | 40.24 | 140 11 | 1/47-12 |
| Thread Laugh | 1/22 | 3/11 | 1/32 |
| Weight, Grams | - | 11/4 | 21/2 |



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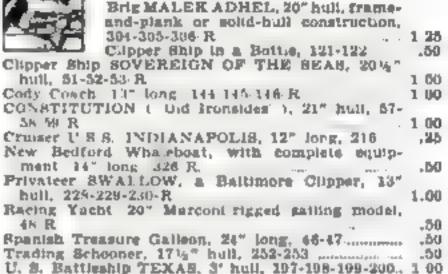
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(Continued on page 208)





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(Continued from page 206)

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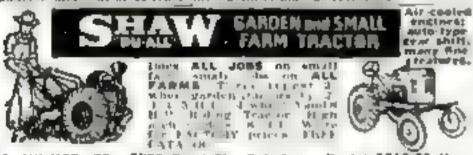
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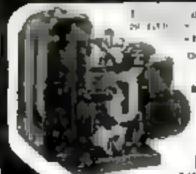


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OIL for lubricating rubber bearings is just as welcome as smallpox. One of the best mixtures seems to be one part each of alcahol and glycerin. The alcohol evoporates and thus leaves a thin film of glycerin.

The prevailing practice in drilling high-speed steels, based on the use of modern equipment, is to use a 135-deg. point (not 118), a 7-deg. clearance, and a web thinned down to half its original thickness.

The modern double-ended end mill is the chesper in the long run. Being a two-in-one tool, it has a low maintenance cost and a minimum lost-production cost.

A certain shop which requires several motorgenerator units has solved a space problem by mounting the generator on top of the motor and using a multiple V-belt drive.

When punckes are needed in press work, it is often economical to counterbore deeper to as to insert a washerlike pad under each punch head. If the punches over get too short, simply remove the pads.

A plain milling cutter is not intended to cut from the extreme ends; however, it can be given side-cutting effects for a limited depth by grinding a 5-deg, relief on the ends of all the teeth.

It doesn't seem possible that 96 percent copper and only 2 percent iron and 2 percent cobalt will produce a metal that hardens like lowcarbon steel. Such a metal, however, is now being made.

Thanks to punch-press safety devices, fewer fingers are being injured, but it would still be a good idea if the ram could drop only when two buttons, located about 18" aport, were pushed zimultaneously.

The cost of mandrels to be used in connection with holes of precisely standard sizes can be reduced by making the tools double-end to serve two different dimensions. That is, of course, in cases where the width of the part is not over twice the internal diameter.

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Copper Wire Stiffens Lamp Gooseneck

on photo lamp stands and other lamps often become worn and can no longer hold the weight of the reflector or shade in the desired position. Simply insert a length of No. 8 copper wire, either bare or insulated, into the neck. This will add to its stiffness.

In some cases, where the connecting wires pass through the neck, there may not be room for the addition of the stiffening wire. It will then be necessary to remove the lamp cord and carry it to the socket on the outside.

—ARTHUR TRAUFFER.



Interting a copper wire to strengthen a limp gooseneck

Making Roll Film Slide Readily into a Reel

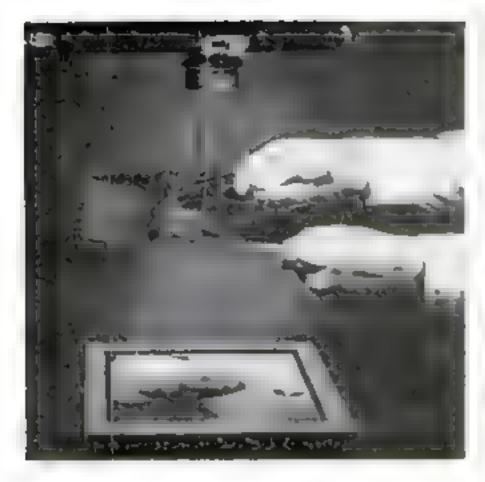


MANY exasperating moments are spent trying to load film in a roll-film tank reel. These can be avoided by a very simple operation. All you have to do is to crease the film lightly back on itself for about 12" as shown. Then unfold and thread on the

reel in the regular way. The crease offsets the natural tendency of the film to curl inward, which makes the film so difficult to push along. It also stiffens the film across its width, eliminating any tendency to buckle. The film will glide along the spiral groove almost as though rolling on ball bearings.—H. S. THOENEBE.

A STRING of ordinary Christmas-tree lights with all red bulbs can be strung along a large darkroom, not to serve instead of a safelight, but to provide a guide for walking about. Each bulb must be provided with a half shade to reflect the light away from the working area.—JOHN E. HELLAWELL.

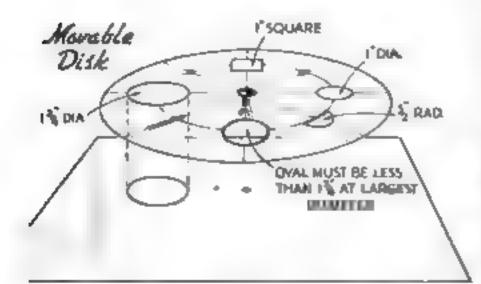
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Dodging Mask Provides Variety of Shapes

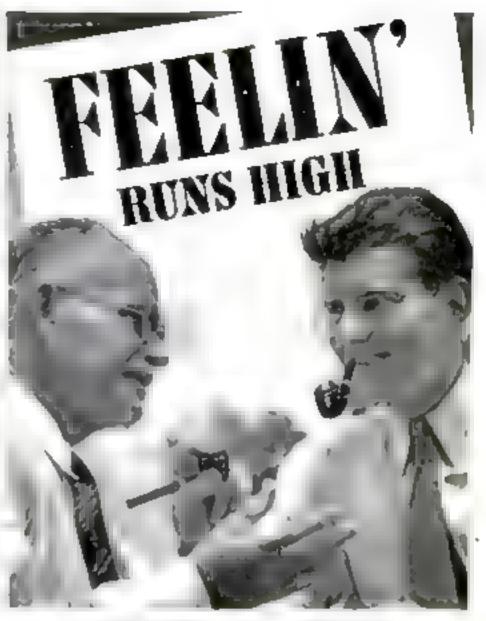
With its various openings, this dodging mask will be found helpful in photographic enlarging. It is made of two pieces of transparent celluloid (preferably red) or other cellulose material. Large discarded photographic film, if the emulsion is removed, will answer the purpose admirably. One piece is about 9" by 11", the other about 8" square. If clear stock is used, red cellulose wrapping tissue is attached to both pieces with rubber cement so the transmitted light will not affect the enlarging paper, which is not sensitive to red rays.

The 8" square piece is then cut into a circle, and openings are cut out with a razor blade as indicated. One large round opening is cut in the main mask. The two parts are assembled with a paper fastener so that any desired opening may be revolved into position over the circular opening in the rectangular mask.—Frank Caporeal.



Transparent red or red-covered celluloid is used for cutting out the two parts of the dodging mask

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How to File Negatives with Photo Data Cards

AMATEL'S photographers who are using the file-card system previously described in this department (P.S.M., Feb. '40, p. 168) can keep the negative of a photograph on the same card with the remainder of the data, provided the negative is smaller than the card. This is done by a slight change in the method of mounting the contact print on the back of the file card. Instead of being pasted on, it is fastened with strips of masking tape along two opposite edges. The negative is then slipped between the print and the card, where it remains as if in an envelope. This not only helps to centralize records, but saves considerable time in the darkroom.-THOMAS F. CONLON.

Tray Catches Developer Spilled from Tank

WHEN developing the largest size film a tank will accommodate, it is necessary to fill the tank as full as possible. Occasionally developer spills over the edge of the tank and is lost. If, however, the tank is set in a clean tray, the excess developer may be recovered.-W. W. LEVIN.



Field Trials for Dogs

(Continued from page 75)

the factors which control scenting conditions. He constructed huge metal funnels, containing delicate spider-web diaphragms. Sunk in the ground, they proved that the earth literally "breathes," air passing out of the ground when it is warmer than the surrounding atmosphere and into the ground when it is cooler than the air. Thus, scenting conditions are best when the earth is warmer than the air.

Near the spot where the Clinton course swings south along the stream, one of the pointers locates the first bird. It "freezes" instantly. The judges note its pointing style. Both head and tail should be held above the line of the back. Then its trainer moves in, raises a pistol, and fires a blank cartridge over the back of the pointing dog. Every animal entered in the meet must pass this test to prove it is not gun-shy.

As soon as they break out of the woods, the two pointers rush this way and that among the bushes and planted patches of grain. Each animal has its individual manner of covering an area. The "pattern" made by its zigzagging course is carefully noted by the two judges. If a dog bolts straight through an area or circles it without thor-

ough investigation, it is penalized.

Spectators on the billside watch the dogs intently. From the "let 'em go!" of the break-away to the "Take 'em up!" of the finleh, a field trial is often a nip-and-tuck struggle, and the minutes in the meadow are among the most vital in the contest. Time after time, the dogs stiffen, scenting the pheasants which have just been released or others previously let loose. The judges have their watches out. The contest has narrowed down to seconds. Then, one of the pointers flushes a bird and breaks after it, chasing it balf across the field in spite of the owner's frantic blasts on the whistle. That blunder gives the higher score to its more steady bracemate.

A few minutes later, while these two pointers are being carefully rubbed down, another pair begins the circuit of the course. So the contest continues, hour after hour. There are exciting upsets; stirring exhibitions of training and skill. And, finally, at the green trailer which forms the temporary headquarters of the club, solid silver plates are awarded to the winners. These animals, the product of scientific breeding and training, have demonstrated the greatest degree of speed, scenting ability, and staming—the three outstanding requisites of the field-trial champion.

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Can We Defend Our Coasts?

(Continued from page 97)

their anchors and control wires stored, and the mines laid at the outbreak of war. Contact mines are used to block off the parts of harbor entrances which need not be used by friendly ships. Controlled mines are used to guard entrances which must be used by friendly shipping and which are within range of the harbor-defense guns and searchlights which protect the fields against sweeping. The electrical control apparatus may be set so that a mine will explode the instant that a ship comes in contact with it, or so that the mine will signal that it has been struck and then will explode after any desired number of seconds—a method which makes it fairly certain that the mine will explode while it is in contact with the bottom of the ship. Until its firing switch is closed, a controlled mine is harmless.

During the peaceful years that followed the end of the World War the Coast Artillery, like the rest of the Army, suffered from the starvation diet imposed on it by inadequate appropriations. Our coast-defense system, which had been one of the world's best, was allowed to go downhill. In 1936 increased appropriations made it possible for the Coast Artillery to start improving our Panama Canal and Hawaiian defenses. Our Pacific Coast harbor defenses also were improved. But until about a year ago our Atlantic and Pacific meacoast defenses were in a decidedly unsatisfactory condition. Since then steady progress has been made in improving them. Some fortifications have been modernized, an undisclosed number of new guns have been mounted, and the defenses against attack from the air have been tremendously increased. But we haven't gone nearly far enough. We need more guns, and we need more highly trained coast artillerymen to handle them.

Harbor defenses can't be improvised in an emergency. It takes close to three years to build a battery of heavy guns. Strong harbor defenses aren't likely to be attacked from the sea because the loss in irreplaceable ships would be too heavy. Weak harbor defenses guarding important ports and cities are an almost irresistible temptation to an enemy fleet, especially at the beginning of a war. Even if our coast defenses never have to fire a shot, their cost will be a very low-priced insurance premium for the protection they give.

Breaklyn, New York

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Flyers by the Ten Thousand

(Continued from page 49)

legians. Only one scholarship winner in each course may be a woman. Those who accept scholarships must pay an additional fee of twenty dollars to cover the cost of physical examination and required insurance.

About 7,000 students started the ground courses early in January of this year, and over 700 winners of C.A.A. and privately offered scholarships, together with non-winners who are paying their own flight-instruction costs of about \$300, now are receiving flying instruction. It is expected that by the end of August nearly all of them will have completed their courses and received licenses.

Women college students showed as keen interest as the men did when the courses were announced last year. Forty students in four women's colleges were accepted. and 324 girls in coeducational institutions. A large proportion of them made the grade, although the percentage of those who failed to win licenses was almost twice as large as that of men. Ground-course instructors told me that the girls usually had to work harder than the men because they weren't so strong in mathematics. One flying teacher said that although all four of the girls in his classes got through all right, they were considerably more nervous than men, and a little slower to learn.

The ground course, which consists of seventy-two one-hour lectures, instructs the students thoroughly in the history of aviation, flight theory, the C.A.A. regulations, air navigation, meteorology, the use of parachutes, the aircraft power plant, instruments, and radio. To go on to the flight course the student must pass an examination with a minimum mark of seventy in each subject.

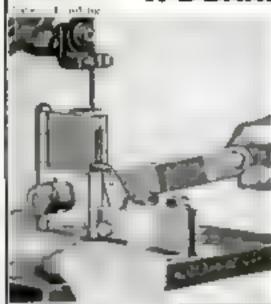
The flying course is given by a C.A.A.approved operator, who must provide one
instructor and one instruction plane for
each fifteen students, at an airport convenient to the college. It is divided into
three stages—a minimum of eight hours of
dual instruction; a minimum of three hours
of preliminary solo flying with one hour of
check flight; and a minimum of fifteen
hours of advanced solo work with eight
hours of dual instruction as a check.

C.A.A. instructors devote the first flying lessons, which are given on the ground, to making the students feel at home in the plane and to simple explanations of the controls and instruments. All instructors agree that nervous and muscular tension is the

(Continued on page 220)



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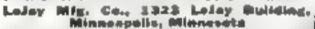
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Flyers by the Ten Thousand

(Continued from page 219)

most deadly enemy of good flying. They are alert for indications that the student is "choking the stick"—getting a drowning man's clutch on the control. This prevents the development of the delicate "feel" by

which good pilots fly.

During early dual flights the instructor, in the front seat, demonstrates simple maneuvers and the student follows his movements on the dual controls. Then the student is allowed to fly the plane except when taking off and landing, with the instructor ready to take over if he makes a serious mistake. In the later lessons of the dual-instruction stage the instructor demonstrates spins and simulated forced landings, and the student is permitted to make into-wind take-offs, and into-wind landings without power.

As soon after the minimum eight hours of dual instruction as the teacher thinks he is competent, the student makes his first solo flight. He devotes at least six halfhour periods, with as much dual check instruction as his instructor thinks desirable. to practicing level flight, turns, glides, and other elementary maneuvers. Then he goes on to advanced solo flight and devotes fifteen hours in the air, checked by eight hours of dual instruction, to precision landings, stalls and spins, power turns, cross-wind take-offs and landings with power, and other advanced maneuvers, leading up to a fifty-mile cross-country solo flight over a triangular course, and finally to the examination for his private-pilot license.

The Civil Aeronautics Authority's pilottraining program has been sensationally successful in training a large number of pilots with a hitherto unknown degree of safety. It is expected that during this coming year at least 600 colleges will offer C.A.A. courses to their undergraduates, and that there will be a proportionate increase in the number of noncollege courses. Many of this spring's graduates intend to enter Army or Navy flying schools after they have completed their advanced courses this

summer. Aiready the program has helped materially to increase the number of licensed pilots in the United States from 33,000 to 45,000 in less than a year. Aviation experts are confident that the expanded program will provide a large number of well-grounded candidates for commissions in our naval and military air services, and that many of its graduates will become pilots of the new fighting planes on which some day the safety of America may depend.

Is It Murder?

(Continued from page 71)

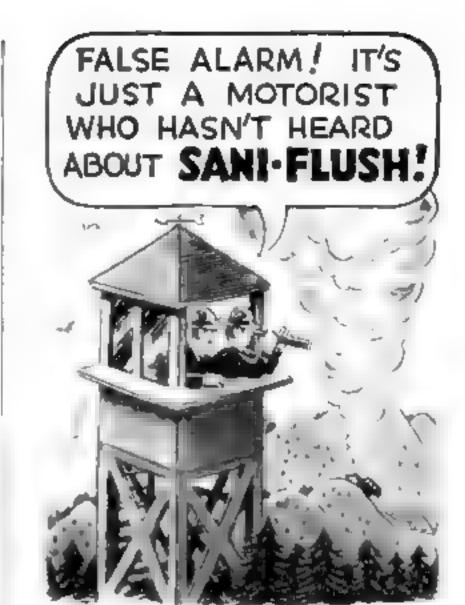
with pen, pencil, nor typewriter. It was the impression left on a sheet of tablet paper when, according to the husband, the original had been produced on the woman's deathbed. He declared he had never been able to find the will itself, but had discovered the tablet with the impression writing on it after his wife's death. John F. Tyrrell, noted Milwaukee authority on questioned documents, was called in to examine the ghost writing. His ingenuity in proving it could not have been produced by the dying woman stands as a classic example of the resourcefulness of the modern scientific sleuth.

Examining the tablet closely, Tyrrell found that the impression was faintly visible down to the fifth sheet. Yet, when he studied the ordinary handwriting of the dead woman, he noted that she used an extremely light touch. The night before his appearance in court, Tyrrell set to work with a piece of wire, a tin funnel, and a pencil. First, he mounted the pencil, point downward, in the bottom of the funnel. Then, he made a loop in one end of the wire and slipped the funnel into it. With this simple apparatus and a bag of lead shot he

appeared in court the next day.

Pouring shot into the funnel, a little at a time, he pulled the weighted pencil along the tablet with a piece of string, at the same time using the wire loop to keep the funnel upright without removing any of the load from the pencil point. Three ounces of shot proved sufficient to produce a line comparable to that found in the known writing of the dead woman. But three additional pounds had to be poured into the funnel before the pressure was great enough to carry the impression down to the fifth sheet of the tablet. In other words, the phantom document supposedly written by the dying woman would have required sixteen times more pressure than she used in normal writing when in full possession of her health and

The absurdity of that story was graphically disclosed by Tyrrell's simple demonstration. Convicted of forging the note and of poisoning his wife, the husband died in the penitentiary. Like scores of other "perfect-crime" killers who have sought to pass off murders as suicides, he overlooked one thing-the skill and resourcefulness of the science-using detective employing all the new discoveries of the laboratory as weapons against the arch criminal, the coldblooded murderer who plots in advance to escape the consequences of his crime,



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Grooming the Iron Cavalry

(Continued from page 101)

as the iron cavalry, artillery must be motorized. The battalion attached to the brigade carries its gun crews in half-track personnel carriers of the same type as is used by the machine-gun troops, and tows its 75-millimeter howitzers behind them. These howitzers have a range of five and a half miles -only about two thirds of the range of the 75-millimeter guns which they have replaced for cavalry use, but their high-angle, lobbing type of fire and quick-aiming characteristics make them decidedly useful to the Mechanized Brigade.

Accompanying the fighting vehicles is the train-big motor trucks loaded with drums of gasoline, ammunition, and food; trucks which are fast-moving machine shops; mobile kitchens which cook as they roll. When the full brigade is marching on a single road its column stretches twenty miles from head to tail.

Ahead of and above the dust-streaked gray-green combat vehicles and trucks fly the planes of the observation squadron. In war their most important mission would be to obtain and report information about the enemy. On peacetime marches their main job is to watch the long column for gaps, and to report them by radio. The commander of the iron cavairy, Brig. Gen. Adna. R. Chaffee—he is one of the Army's most brilliant cavalry officers and in his younger days was one of its top competitive ridersoften controls the march from the air.

In an all-motorized, all-mechanized force equipped with close to 600 vehicles, many of them of exceptionally complicated character, maintenance becomes a major problem.

When the brigade is on the move, each troop is followed by its maintenance truck, whose crew makes any roadside repairs it can handle. Regimental maintenance trucks follow each regiment, and their crews take care of more serious breakdowns. At the tail of the column roll the trucks of the ordnance maintenance company—trucks loaded with spare parts and even spare engines, machine-shop trucks, a generator truck which provides electric lights for the field machine shop which is set up each evening in a big, square tent. Wreckers tow disabled vehicles to the night's bivouac, and the rule is that the cripples must be ready to roll when the brigade marches in the morning march last year the maintenance companies handled eleven major repair jobs in one night, putting in 263 man labor hours doing it. At the end of the 700-mile trek the brigade had all but two of its combat cars

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and all its other vehicles except one halftrack in condition to take part in a strenuous tactical exercise.

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A hundred and fifty miles is a normal day's march for the Mechanized Brigade. Marching from Fort Knox to Plattsburg last summer, it did 1,000 miles in six days. On one occasion it marched 330 miles in a little over twenty-four hours. These marches weren't made under war conditions, of course, but the iron cavalry moves fast—and it can hit hard when it gets there.

The younger soldiers of the Mechanized Brigade have served only in the iron cavalry. They were attracted to it through their interest in automobile mechanics and by the fact that it is something brand new. The brigade has no difficulty in filling its ranks

with high-grade recruits.

Nearly all the officers and many of the noncommissioned officers are former horse cavalrymen. Some of them I talked with admitted that they missed the horses, but all of them were keenly interested in their new jobs. An old top sergeant, with a lot of service stripes on his sleeve, said: "When you first come to the Mechanized Brigade from a horse regiment, everything seems strange to you, And then you begin to realize that, after all, the Mechanized Brigade isn't so very different from any other cavalry outfit—that you're really doing the same things for the same reasons, only you're doing them in new ways. Cavalry is cavalry, whether you're riding a horse or driving a hell buggy."

POPULAR SCIENCE Question Bee

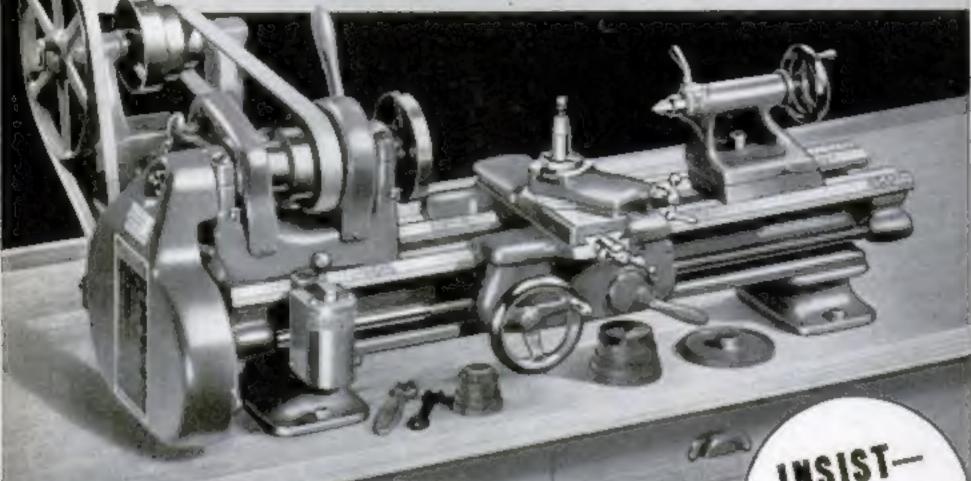
THESE are the correct answers to the Question Bee on page 116. Give yourself five points for each one you had right. A total score of 75 to 85 is good; 90 or better is excellent.

1. d 6. No 11. Mole 16. Fauna 12. Plane 2. c 7. No. 17. Tackle 3. a. 8. Yes 13. Jack 18. Longitude 14. Root 4. b 9. No 19. Strain 5. C 15. Tap 10. Yes 20. Bit



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